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Pepperdine University  
Graduate School of Education and Psychology

ON THE VALIDITY AND RELIABILITY OF THE COMPUTERIZED MEMORY  
INTERFERENCE TEST FOR PRIMARY SPANISH-SPEAKING INDIVIDUALS

A clinical dissertation submitted in partial satisfaction  
of the requirements for the degree of  
Doctor of Psychology  
by

Reneh Karamians, M.A.

November, 2015

Daryl Rowe, Ph.D.-Dissertation Chairperson

This clinical dissertation, written by

Reneh Karamians

under the guidance of a Faculty Committee and approved by its members, has been submitted to and accepted by the Graduate Faculty in partial fulfillment of the requirements for the degree of

DOCTOR OF PSYCHOLOGY

Doctoral Committee:

Daryl Rowe, Ph.D., Chairperson

Enrique Lopez, Psy.D.

Judy Ho, Ph.D.

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## TABLE OF CONTENTS

	Page
LIST OF TABLES .....	vi
ACKNOWLEDGMENTS .....	vii
VITA .....	viii
ABSTRACT .....	xx
INTRODUCTION .....	1
Memory Defined .....	2
Visual Memory .....	3
The PMIT: Background and History .....	5
The CMIT and What it Measures .....	6
Validity .....	7
Reliability .....	8
The Reliability and Validity of Current Measures.....	10
The WMS-III, Visual Reproduction Subtests.....	10
The Rey Auditory Verbal Learning Test .....	10
The WAIS-III.....	11
The Need for Culturally Appropriate Instruments.....	13
Characteristics of the Population Under Study .....	15
Summary .....	15
RESEARCH METHODS .....	18
Participants.....	18
Instruments.....	18
Administration of the CMIT .....	18
Part A, The Demographic Questionnaire.....	19
Part B, The Pre-Test Trial .....	20
Part C, Book 1 .....	20
Part C, Book 2.....	21
Part C, Book 3.....	21
Part D, Book 4.....	21
Part E, Book 5 The Reaction Time Test .....	22
CMIT Scoring .....	22
Administration of the WMS-III VR I and VR II .....	23
Administration of the RAVLT .....	23
Administration of the WAIS-III.....	23
Procedures and Data Analysis .....	27

	Page
Phase A, B, C, & D: Correlations Between CMIT Scores and WMS-III VR I and VR II, RAVLT and the Three WAIS-III Subtest Scores Collected for the Control Group .....	27
Phase E.....	28
Phase F .....	29
Importance and Purpose of Study .....	29
Hypothesis 1.....	30
Hypothesis 2.....	30
Hypothesis 3.....	30
Hypothesis 4.....	31
Hypothesis 5.....	31
RESULTS .....	32
Correlations.....	32
Correlations Between the CMIT and the WMS-III VR I and VR II .....	32
Correlations Between the CMIT and the RAVLT .....	32
Correlations Between the CMIT and the WAIS-III.....	34
ANOVA Between Individuals With and Without HAND.....	35
CMIT Internal Consistency.....	36
DISCUSSION .....	37
Hypothesis One.....	37
Hypothesis Two .....	38
Hypothesis Three .....	39
Hypothesis Four .....	40
Hypothesis Five .....	41
Limitations and Implications for Further Research .....	41
Final Comments .....	42
REFERENCES .....	44
APPENDIX A: Literature Review Table.....	50
APPENDIX B: Tables .....	108
APPENDIX C: IRB Exemption Notice .....	116

## LIST OF TABLES

	Page
Table B1: Sample Frequencies by Education .....	101
Table B2: Sample Frequencies by Age .....	102
Table B3: Sample Frequencies by Gender .....	103
Table B4: Analysis of Distribution .....	104
Table B5: Correlations Between PMIT Scores and Related Constructs .....	105
Table B6: Mean CMIT Scale Scores for Individuals With and Without HAND.....	106
Table B7: CMIT Internal Consistency.....	107

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With the completion of this dissertation I would like to, first, extend my thanks to my committee. As Chairperson, Dr. Daryl Rowe has been extremely patient and supportive. He has allowed me to find my own path and was always available to provide his expert input on topics of multicultural practice in psychology. Dr. Lopez was instrumental in assisting with the development of the research design and was gracious enough to make available his archival data for the purposes of this study. Dr. Ho has also been extremely supportive and her input in regards to the statistical analysis of the data was greatly appreciated. Dr. Ho was also extremely helpful as I attempted to finalize the study.

I would like to extend my thanks to my parents Mr. and Mrs. Arsen and Hilda Karamians for always supporting me in my many endeavors. I would also like to thank my brother, Mr. Arbi Karamians, for his support and encouragement as well as my friends Mrs. Lauren Jones-LeRoy, Dr. Sara Ormseth and Dr. Cristina Yamakawa for all of their support through some difficult times. Finally, I would like to extend my thanks to Dr. John Leffler, my mentor, who first guided me towards the sciences. Without Dr. Leffler, none of this would have been possible.



## VITA

### RENEH KARAMIANS

#### Education

##### **Erie Psychological Consortium, Erie, PA**

*Completion of Predoctoral Internship*

August, 2014

- **APA-accredited** predoctoral internship,
- Trained in Neuropsychology and CBT
- Facilities included:
  - University of Pittsburgh Medical Center HAMOT
  - Health South of Erie Rehabilitation Center
  - Northshore Psychological Associates
  - Safe Harbor Behavioral Health

##### **Pepperdine University, Los Angeles, CA**

*Doctoral Degree in Clinical Psychology, expected*

December, 2015

**APA-accredited** doctoral program in clinical psychology.

Dissertation: *On the Validity and Reliability of the Computerized Memory Interference Test for Primary Spanish-speaking Individuals*

##### **Pepperdine University, Los Angeles, CA**

*Master of Arts in Psychology,*

August, 2007

##### **Ferrum College, Ferrum, VA**

*Bachelor of Science in Biology,*

*minor in Continental Philosophy and Chemistry,*

Thesis: *On the Nature of Human Subjectivity*

May, 2003

#### Clinical Experience

August, 2013-August, 2014

**Location:** Erie Psychological Consortium, Erie, PA

**Position:** Neuropsychology/Psychology Intern

**Supervisors:** John Hecker, Psy.D, Michal Schwabenbaur, Ph.D, ABPP, Richard Sekula, Ph.D.

##### Clinical Training by Facility

- **University of Pittsburgh Medical Center HAMOT**
  - Administered, brief, bedside neuropsychological assessments to patients who had suffered traumatic brain injuries, stroke or were suffering from movement disorders
  - Scored and interpreted results of neurocognitive testing
  - Dictated neuropsychological reports and made treatment recommendations
  - Attended monthly neuropsychology grand rounds, along with medical staff and neurology residents, covering a variety of topics in neuropsychology including

assessment of various neurocognitive domains, assessment of specific neurocognitive and neurological disorders and administration of neuropsychological instruments

- Observed neurosurgical interventions including resection of Venous Malformation

○ **Health South of Erie Rehabilitation Center**

- Administered initial, bedside neuropsychological assessments to patients suffering from a variety of disorders including various dementias, stroke, movement disorders, apraxia and aphasia
- Administered, formal bedside neuropsychological assessments to patients suffering from a variety of disorders including various dementias, stroke, movement disorders, apraxia and aphasia
- Scored and interpreted results of neurocognitive testing
- Dictated neuropsychological reports and made recommendations for further, more formal assessment of patients post discharge
- Attended weekly team meetings with psychiatrists, speech therapists, physical therapists and nurses to provide feedback to the interdisciplinary team regarding the neurocognitive status of inpatients
- Assessed patients suffering from various neurocognitive and neurological disorders for capacity to make medical decisions

○ **Northshore Psychological Associates**

- Administered fully integrated neuropsychological and emotional assessments to outpatients suffering from a variety of disorders including dementia, movement disorders, traumatic brain injuries, sports related concussions and attentional disorders
- Scored and interpreted results of neurocognitive and emotional testing
- Prepared full neuropsychological reports with recommendations for further interventions by neuropsychology and medical staff
- Provided feedback to patients regarding the results of their neurocognitive assessments and the prognostic implications of the results
- Attended monthly didactics in ethics and ethical practice in psychology and assessment psychology
- Attended monthly didactics in multicultural practice of psychology and neuropsychology
- Completed formal course training in Psychopharmacology, stroke and movement disorders
- Attended multiple conferences, as required by internship curriculum, in topics such as neurosurgical interventions, sports concussion, advances in neuroscience, ethics and educational psychology

○ **Safe Harbor Behavioral Health**

- Conducted neurocognitive and cognitive assessment for outpatients being assessed for a variety of disorders including various dementias, attentional disorders and learning disorders
- Scored and interpreted results of neurocognitive and cognitive testing
- Prepared full neuropsychological and cognitive assessment reports with recommendations for further interventions by psychology and medical staff

- Provided feedback to patients regarding the results of their neurocognitive assessments and the prognostic implications of the results
- Conducted prescreening assessments for bariatric surgery with full reports providing recommendations regarding patient fitness for bariatric surgical interventions
- Conducted individual therapy with adults, children and couples suffering from a variety of emotional difficulties including, depression, anxiety, Obsessive Compulsive Personality Disorder and Bipolar Disorder
- Obtained formal training in crisis intervention (via ASSIST training and certification)
- Received weekly supervision for both individual therapy as well as neurocognitive and cognitive assessment of clinic patients

October, 2010-October, 2013

**Location:** Cedars-Sinai, Dept. of Psychiatry/Dept. of Neurology, Beverly Hills, CA

**Position:** Chief Neuropsychology Extern

**Supervisor:** Cristina Yamakawa, Psy.D, Enrique Lopez, Psy.D

- Assisted with the training of other practicum students in the administration of neuropsychological instruments and protocols for various research projects
- Conducted full neuropsychological assessments, intake interviews, chart reviews and developed treatment plans for both outpatients as well as inpatients suffering from a wide range of disorders including traumatic brain injury, movement disorders and various dementias
- Provided feedback to patients and patient families regarding the results of neurocognitive assessments and prognostic implications of their current neurocognitive status
- Assessed patients and research participants using instruments such as, PANSS, SCID-I and MADRS and MINI
- Attended weekly grand rounds led by psychiatrists and other mental health professionals presenting on a wide variety of topics including substance dependence, neurological disorders and neuroanatomy
- Assisted in the modeling and development of multiple computerized neuropsychological instruments (using SuperLab Software)
- Coauthored Neuropsychnorms.com 1st edition
- Assisted in the writing of R01 as well as K23 grants for presentation to the National Institute of Health
- Participated in the preparation of multiple publications with clinical neuropsychologists as well as psychiatrists
- Developed multiple Excel based scoring programs for various research projects

September, 2009- September, 2011

**Location:** Bienvenidos Children's Center, Montebello & Pasadena, CA

**Position:** Psychology/Neuropsychology Extern

**Supervisor:** Bruce Rush, Psy.D

- Conducted neurocognitive, cognitive and emotional assessments of child and adolescent outpatients suffering from a variety of disorders including traumatic brain injury, attentional disorders and learning disorders using neuropsychological instruments as

well as instruments for the assessment of emotional functioning such as MMPI-A and MMPI-2

- Scored and interpreted integrated neurocognitive and cognitive assessment batteries
- Produced full neuropsychological and cognitive assessment reports with recommendations for further intervention by psychology and medical staff
- Provide feedback to patients and patient families regarding results of assessments and the prognostic implications of their neurocognitive and cognitive status
- Conducted individual therapy and family therapy sessions for child and adolescent outpatients suffering from a variety of emotional and behavioral disorders including depression, anxiety and Conduct Disorders
- Attended weekly trainings on a variety of topics including treatment planning, test administration and test interpretation

August, 2009- August, 2010

**Location:** Sports Concussion Institute, Los Angeles, CA

**Position:** Neuropsychology Extern

**Supervisor:** Tony Strickland, Ph.D

- Administered comprehensive neuropsychological batteries for a variety of cases including forensic, traumatic brain injury and Post-Concussion Syndrome
- Administered ImpACT measure assessing athletes suffering from Post-Concussion Syndrome
- Scored and interpreted results of neurocognitive assessments
- Produced full neuropsychological and cognitive assessment reports with recommendations for further intervention by psychology and medical staff
- Provide feedback to patients and patient families regarding results of assessments and the prognostic implications of their neurocognitive and cognitive status
- Conducted cognitive rehabilitation sessions treating patients with traumatic brain injury
- Produced full neuropsychology reports interpreting test results for a variety of referral sources including the California Civil Court System, as well as various neurologists and psychiatrists

July, 2008- July, 2009

**Location:** UCLA-Olive View Medical Center, Dept. of Psychiatry, Sylmar, CA

**Position:** Neuropsychology Extern

**Supervisor:** Hope Goldberg, Ph.D

- Conducted intake interviews, chart reviews and developed treatment plans for both inpatients and outpatients
- Administered and scored full and brief neuropsychological batteries with inpatients as well as outpatients suffering from a wide range of disorders including psychosis, dementia and Conversion Disorder
- Produced full and brief reports interpreting the results of neurocognitive testing
- Provided feedback to patients and families regarding the results of neuropsychological testing and the prognostic implications of their neurocognitive status
- Presented cases in both weekly individual and weekly group supervisory sessions

- Attended monthly grand rounds led by physicians and other mental health professionals presenting on a variety of topics including neurocognitive disorders and psychiatric disorders
- Attended weekly psychiatric staff team meetings to discuss status and treatment of inpatients
- Trained both inpatients as well as hospital staff in behavioral modification methods and effective interpersonal interaction and communication
- Served as translator and cultural consultant for hospital staff in the treatment of Armenian patients and their families

August, 2007- August 2011

**Location:** Pepperdine Educational and Psychological Clinic, Los Angeles, CA

**Position:** Doctoral Practicum Therapist

**Supervisor:** Aaron Aviera, Ph.D, Edward Shafranske Ph.D, Sepida Sazgar, Psy.D

- Conducted intake interviews and developed treatment plans for outpatients suffering from a variety of disorders including depression, anxiety, trichotillomania, psychosis and gender related issues
- Administered biweekly emotional assessment of outpatients using instruments such as the BDI, BAI, QIDS and RDQ
- Provided long-term psychotherapy for adults and adolescents with a wide range of Axis-I and Axis-II disorders
- Participated in weekly group supervisory sessions during which cases were presented and treatment plans were discussed and developed
- Participated in weekly dyadic supervision
- Participated in weekly one-on-one peer supervisory sessions
- Trained in both psychodynamic as well as CBT treatment modalities

## Research Experience

October, 2010- October, 2012

**Location:** Cedars-Sinai, Beverly Hills, CA

**Position:** Chief Neuropsychology Extern

**Supervisor:** Enrique Lopez, Psy.D, Cristina Yamakawa, Psy.D

- Development of the ROXROLS Instrument
  - Assisted in the statistical analysis of a study investigating the reliability and validity of a newly developed instrument (the ROXROLS) for the assessment of children and adolescents with developmental disabilities
  - Instruments employed in study included CGI, ROXROLS, ABC and BPI
  - Assisted in the presentation of poster at American Academy of Child and Adolescent Psychiatry
- NIH Funded HIV Study
  - Assisted in the development of a cognitive rehabilitation program to help participants with medication adherence

- Assisted with the training of other practicum students regarding study protocols as Chief Practicum Extern
  - Developed a computerized neuropsychological instrument (the n-Back), using the SuperLab Software, to be normalized within the study
- Clintara AstraZeneca Study
  - Assisted in the selection process of participants for the clinical trials of a newly developed antidepressant for Clintara and AstraZeneca
  - Assisted in the development of research protocols
  - Assisted in the training of other practicum students in the administration and scoring of instruments used in study as Chief Practicum Extern
  - Assisted with the training of other practicum students regarding study protocols as Chief Practicum Extern
- Multiple Sclerosis Study
  - Administered neuropsychological batteries and the SCID-I and SCID-II to participants of a study investigating the effects of depression on individuals with Multiple Sclerosis
  - Assisted in the development of research protocols
  - Assisted in the training of other practicum students in the administration and scoring of instruments used in study as Chief Practicum Extern
  - Assisted in the training of other practicum students regarding study protocols as Chief Practicum Extern
- Alzheimer's Disorder Study
  - Assisted in the development of research protocols
  - Assisted in the training of other practicum students in the administration and scoring of instruments used in study as Chief Practicum Extern
  - Assisted in the training of other practicum students regarding study protocols as Chief Practicum Extern

## **Pre-Doctoral Research Experience**

June, 2003- August, 2003

**Location:** USAID BOLFOR, Santa Cruz, Bolivia

**Position:** Intern field researcher

**Supervisor:** Todd Frederiksen, Ph.D

- Collected data from designated rainforest research sites and logging gaps created by illegal logging
- Participated in data entry and analysis of data collected from various research sites
- Assisted in the preparation of manuscripts presented for publication

September, 2001-September, 2002

**Location:** Ferrum College, Ferrum, VA

**Position:** Student Lab Assistant

**Supervisor:** Ron Stephens, MA

- Collected microbial samples from a local aquatic system
- Identified microbial samples using the BiOLOG bacterial identification system
- Identified microbial samples using manual methods
- Prepared all media used in study

September, 2001-September, 2002

**Location:** Ferrum College, Ferrum, VA

**Position:** Independent Student Researcher

**Supervisor:** Bob Pohlads, PhD

- Conducted research on the BiOLOG bacterial identification system
  - Assessed the economic efficacy and accuracy of the system
  - Assessed the efficacy of BiOLOG procedures and methodology
  - Assessed the level of skill required to employ the instrument

### **Additional Training**

August, 2014

**Location:** Erie, PA

**Institution:** University of Pittsburgh Medical Center

**Training:** Observation of Neurosurgical Intervention

- Observed the resection of a Venous Malformation within the fronto-temporal region of the brain via neurosurgical intervention
- Discussed the clinical implications of the procedure with the primary surgeon, assisting surgeon as well as the assisting neurologist

April, 2014

**Location:** Edinboro, PA

**Presenter:** Mark Kelso

**Title:** Confronting the Sports Concussion Crisis

- Trained in the neuropsychological assessment of sports related concussions
- Received informational training on the history of the treatment of sports related concussions
- Received informational training on current and soon to be developed technologies to be employed in athletic events to decrease/prevent head injuries (e.g., helmets)

May, 2014

**Location:** Franklin, PA

**Presenters:** Multiple Presenters

**Title:** University of Pittsburgh Medical Center, Northwest Stroke Symposium

- Trained in the neuropsychological assessment of stroke (e.g., signs and symptoms)
- Received informational training in regards to the causes of strokes
- Trained on current medical and surgical procedures for the treatment of stroke

March, 2014

**Location:** Erie, PA

**Presenter:** Multiple Presenters

**Title:** In the Crosshairs of Change

- Trained and informed of the potential changes to be expected within healthcare and its implications to clinical practice
- Trained on implications of “Obama Care” to clinical practice

March, 2014

**Location:** Erie, PA

**Presenter:** Patrick M Connell

**Title:** DSM-5: The diagnosis of Dementia

- Trained in the changes made to the DSM-IV-TR in the DSM-5
- Received additional training on the step-by-step use of the DSM-5 for the diagnosis of Dementia and sleep disorders

January, 2014

**Location:** Erie, Pa

**Presenter:** Multiple presenters

**Title:** ASSIST

- Trained in assessing suicidal ideation
- Trained in applied intervention skills for suicidality
- Trained in providing treatment recommendations and follow-up for patients presenting with suicidal ideation
- Certified in ASSIST

October, 2013

**Location:** Harrisburg, PA

**Presenters:** Molly Haas Cowan, Psy.D, John Mills, Ph.D, Jeanne Slattery, Ph.D

**Title:** Positive Multiculturalism as Aspirational Ethical Practice

- Trained in conceptualizing multicultural approaches to clinical practice
- Trained in application of multicultural approach to clinical practice
- Discussed implications of culture on clinical practice, assessment, diagnosis and prognosis
- Discussed ethical implications of multicultural practice

October, 2013

**Location:** Harrisburg, PA

**Presenters:** Sam Knapp, Ed.D, Linda Kauss, Ph.D, ABPP, Edward Zuckerman, Ph.D

**Title:** How to Teach Ethical Issues Concerning Telehealth & Electronic Records

- Trained in ethical protocols in using electronic records and telehealth practice
- Discussed implications of telehealth practice
- Trained on various software available for the implementation of telehealth practice



October, 2013

**Location:** Harrisburg, PA

**Presenter:** Sam Knapp, Ed.D, ABPP

**Title:** Law and Ethics Review

- Discussed APA and PPA ethical guidelines
- Participated in analysis of ethical protocols via vignettes
- Gained a more comprehensive understanding of ethical guidelines in APA ethics code

March, 2012

**Location:** Cedars-Sinai Medical Center

**Training:** Use of the SCID-I

- Gained an understating of the Structured Clinical Interview for DSM-IV (SCID-I)
- Trained in the administration of the SCID-I
- Tainted in the use of the SCID-I in research
- Certified to administer the SCID-I

September, 2011

**Location:** Cedars-Sinai Medical Center

**Training:** Use of the HAM-D17

- Gained an understating of the structure of the HAM-D 17
- Trained in the administration of the HAM-D17
- Certified for the use of HAM-D 17 for assessment of depression by the “Bracket” company

September, 2011

**Location:** Cedars-Sinai Medical Center

**Training:** Use of the MADRS

- Gained and understanding of structure of the MADRS
- Trained in the administration of the MADRS
- Certified to administer MADRS for assessment of depression by Bracket

August, 2010

**Location:** Los Angeles, California

**Event:** Fifth Annual Sports Concussion Summit

**Presenter:** Various Presenters

- Attended lectures on assessment and treatment of sports related head injuries
- Participated in organizing and facilitating summit activities

August, 2008

**Location:** Alliant International University, Alhambra, CA

**Presenter:** Yossef S. Ben-Porath, Ph.D

- Trained in, and gained an understanding of the changes made to the instrument
- Trained in the administration and interpretation of the MMPI-2-RF
- Discussed implications of the new instrument of clinical practice

October, 2008

**Location:** Alliant International University, Alhambra, CA

**Presenter:** Various Presenters

- Trained in the administration and interpretation of the WAIS-IV
- Trained in the changes made to the newly developed instrument

## **Work Experience**

October, 2012- October, 2013

**Location:** Cedars-Sinai, Psychological Trauma Center, Beverly Hills, CA

**Position:** Staff Research Assistant II/Data Analyst

**Supervisor:** Suzanne Silverstein, MA, ART

- Supervised master's level volunteers involved in research projects
- Analyzed collected data using both SPSS and Excel software
- Developed research questions for various research studies
- Assist in the writing of grants, posters and research articles

November, 2006- November, 2007

**Location:** Canfield Elementary, Via Kayne Eras, Los Angeles, CA

**Position:** Behavioral Specialist

**Supervisor:** Bitia Tabiani, M.A.

- Monitored and recorded the client's maladaptive behaviors in a classroom setting
- Employed ABA methodology to modify client's maladaptive behaviors
- Recorded improvements in the client's maladaptive behaviors in a classroom setting
- Worked with client's family and teachers to facilitate a consistent environment for the client with clear expectations of client's behaviors described
- Participated in weekly supervision with doctoral level graduate student
- Participated in monthly supervision with a licensed psychologist

April, 2005- April, 2006

**Location:** Kayne Eras Center, Culver City, CA

**Position:** Teacher's Assistant

**Supervisor:** Mona Alberts, M.A.

- Monitored client's maladaptive behaviors in a classroom setting
- Reported to the center's therapists the client's current status and as well as changes in the client's behaviors
- Attended monthly trainings in a range of areas, including the reporting of abuse, stress management techniques and physical restraint techniques
- Taught arithmetic and physical science to fifth, sixth, seventh and eighth graders in a special education classroom setting

## **Publications**

Peselow, E., **Karamians, R.**, & IsHak, W. (2015). Prophylactic efficacy of Fluoxetine, Escitalopram, Sertraline and Paroxetine in unipolar depression: Outcome after long-term follow-up. *Psychiatry Research*. 225, 680-686

Peselow, E., D., **Karamians, R.**, Lord M., Tobia G.& IsHak W.,W., (2013). The discrepancy between patients and informants on clinician-rated measures in Major Depressive Disorder: Implications for Clinical Trials and Clinical Practice. *International Clinical Psychopharmacology*. 29(2), 111-115

Lopez, E., Yamakawa, C., **Karamians, R.**, Smith, K., Pfluegl, G. & Hardy, D., (2013, February). *The effectiveness of the Computerized Picture Memory Interference Test in the detection of HIV associated neurocognitive disorder (HAND) among Spanish speaking individuals infected with HIV*. Poster session presented at the annual meeting of the International Neuropsychology Society, Waikaloa, Hawaii.

**Karamians, R.**, Yamakawa, C. & Lopez, E., (2013, February). *The effectiveness of the HIV Dementia Scale (HDS) in the Detection of HIV Associated Neurocognitive Disorder (HAND) among Spanish Speaking Individuals Infected with HIV*. Poster session presented at the annual meeting of the International Neuropsychology Society, Waikaloa, Hawaii.

Szeftel, R., Lopez, E., Yamakawa, C., Scott, S. & **Karamians, R.**, (2012, October). *Development and validation of the restrictiveness of living scale: A rapid settings-based assessment of problem behaviors in the developmentally disabled population*. Poster session presented at the annual meeting of the American Academy of Child and Adolescent Psychiatry, San Francisco, CA.

Lopez, E., D'Elia, L., Hardy, D., Chilingar M., Holt, T. & **Karamians, R.** (2006). *Computerized scoring program for the Handbook of Normative Data for Neuropsychological Assessment, 2<sup>nd</sup> edition*. Retrieved from [www.neurpsychnorms.com](http://www.neurpsychnorms.com).

**Karamians, R.** (2006). Dasein and the arts. *Philosophy Now*, 57, 10-11

## **Publications in Submission & Preparation**

**Karamians, R.** (2015). The hopelessness-helplessness model of depression: The role of worrying in the development of depression. *American Journal of Psychology*. Manuscript submitted for publication.

**Karamians, R.** (2015). The role of socioeconomic status and ethnicity on depressive symptoms. *American Journal of Psychology*. Manuscript submitted for publication.

## **Presentations**

July, 2014

**Location:** Erie, PA

**Title:** Does your lifestyle/mood affect your blood pressure?

- Presented to residence of a local assisted living facility

July, 2014

**Location:** Erie, PA

**Title:** Sports Related Concussion

- Presented to the Millcreek Athletic Association and the parents of student athletes in the Millcreek, PA area

## **Awards & Honors**

- Winner of the innovations in instrument development in Neuropsychology, 1<sup>st</sup> place, Cedars-Sinai (2012)
- Psi Chi, National Honors Society (2006)

## **Professional Associations**

- American Psychological Association, student affiliate
- Pennsylvania Psychological Associate, student affiliate
- American Philosophical Association, student associate

## **Language**

- Fluent in Armenian

## ABSTRACT

In this study, the Computerized Memory Interference Test (CMIT), a derivative of the Picture Memory Interference Test (PMIT) was assessed for reliability, validity and internal consistency with a primary Spanish-speaking sample. Five hypotheses were formulated and tested. For the first hypothesis correlational studies assessing relationships between the CMIT scores and those of the WMS-III, Visual Reproduction subtests were used to establish convergent validity. Hypotheses two and three, produced correlational studies to assess relationships between the CMIT scores and those of the RAVLT and WAIS-III Block Design, Vocabulary and Matrix Resonating subtests. To test the fourth hypothesis, known-group methods were used to assess the reliability of the CMIT. Cronbach's *Alpha* was used to determine the internal consistency of the CMIT. Results indicated that the CMIT scores and those of the WMS-III, Visual Reproduction subtests correlated at a statistically significant level confirming convergent validity. Results also showed statistically significant correlations between the CMIT scores and the RAVLT subtest scores as well as those of the WAIS-III subtests. Due to these results, discriminant validity was not considered established. However, the CMIT did prove to be sensitive to detecting visual memory deficit, and internal consistency was also established for this population.

## **Introduction**

Clinical neuropsychology has become a front-runner among the many specialties available to psychologists and, currently, most doctoral level programs offer exposure to neuropsychological practice, even prior to the pre-doctoral internship (Stucky, Bush, & Donders, 2010). In addition to clinical practice, however, many neuropsychologists also work to develop the instruments used to assess the various domains of cognitive functioning (e.g., attention and concentration, memory, language, and visual spatial processing, etc.). Among these instruments, those assessing memory have been the most widely used (Sander, Nakase-Richardson, Constantinidou, Wertheimer, & Paul, 2007) and currently, various assessment tools, which measure the many aspects of memory, are available to clinical and research neuropsychologists. Unfortunately, the majority of these instruments are not necessarily appropriate for use with members of various ethnic groups. In the field of assessment psychology, it has now become a maxim that culturally appropriate instruments are required for the proper assessment of memory as they are for all cognitive domains (American Psychological Association, 2002). Yet, the current methodology employed to construct cognitive assessment tools, in general, do not allow for the development of culturally unbiased instruments (Manly & Echemendia, 2007).

Typically, after a neuropsychological measure of memory has been carefully vetted and developed, normalization data is collected via administration of the instrument to the general population. Though this method provides researchers and clinicians with standardized normalization data and guidelines for assessing memory functioning of members of the general population, it does not provide specific guidelines or normalization data for assessing the members of various ethnic groups which neuropsychologists often assess (Manly & Echemendia, 2007).

## Memory Defined

To examine these issues more closely, it is important to first understand the various aspects of memory as well as the context in which modern day models of memory were developed. The modeling of memory functioning within the human brain has been widely researched since the work of Ebbinghaus in 1885 (Reynolds & Bigler, 1995). However, even with the extensive contributions to the literature made by many researchers (e.g., Luck & Vogel, 1997; Rouder, Cowan, Zwillig, Morey, & Pratte, 2008; Wheeler & Treisman, 2002), working models of memory functioning have not been easy to develop (Cowan, Rouder, Blume, & Sauls, 2012). This has often been attributed to the brain's complexity in neural circuitry (Delacour, 1994). Though modeling this domain has been a daunting journey for researchers throughout the years, many models have been developed which seem to hold.

It was in the 1960s, during which modern models of memory began to be developed. At the time, human memory was often compared to the memory utilized within computers (Delacour, 1994; Sander et al., 2007). As an example, Atkinson and Shiffrin's (1968) *Modal Model* (or *Multi-store Model*) of memory theorized that human memory functioned in a sequential manner not unlike how computers of the time processed information. However, computer models did not seem to hold, and more sophisticated models continued to develop (Shelton, Martin, & Yaffee, 1990). One such model was Baddeley's (1986) model of working memory, which emphasized the significance of motivation and attention in human memory functioning. Not long after Baddeley's work, Schneider and Detweiler (1987) postulated that memory, as a domain, is dependent on many other domains. It was hypothesized that various memory systems exist. These included those of mood memory, semantic memory, speech memory, motor memory, auditory memory, visual memory, as well as contextual memory. This model created a new paradigm and a new way of looking at memory.

Since then, it has been conceptualized that, anatomically, memory exists within multiple areas of the brain. Delacour (1994) hypothesized that lesions or damage to a variety of areas of the brain can lead to specific deficits in memory. As an example, it is widely held that the bilaterally located hippocampi are more than likely the most important regions associated with human memory (Kumaran & McClelland, 2012). Damage to the hippocampi has been shown to cause deficits in various domains of memory such as delay recall, spatial representation, spatial recognition and working memory (Heuer & Bachevalier, 2011). It has also been documented that damage to the right-lateral temporal lobe seemingly causes deficits in non-verbal based memory (e.g., orientation, facial recognition), while damage to the left-lateral temporal lobe causes deficits in verbal or symbolic memory (Lezak, Howieson, Bigler, & Tranel, 2012; Squire & Zola-Morgan, 1991). In contrast to these, damage to the frontal regions of the brain do not seem to effect any specific aspects of memory, but rather cause deficits in attention which, in turn, affect the proper registration and encoding of information and can also affect the recall of the information stored within the hippocampi. Further, lesions within the lower levels such as the hypothalamus, thalamus, and reticular formation have also been shown to cause memory difficulties related to attention and motivation (Delacour, 1994; Lezak et al., 2012; Markowitsch, 1994).

Though a significant amount of attention has been placed on explaining and localizing specific memory systems within the brain, the development of an accurate model has been difficult (Delacour, 1994). Further, sub-domains of memory in general, such as visual memory, have been even more challenging to delineate.

### **Visual Memory**

Hollingworth and Luck (2008) have provided a great deal of insight into the nature of visual memory. They assert that the term *visual memory* is used to describe circumstances in



which information from the environment is initially obtained via the visual inputs and, in turn, registered and encoded within the visual cortex. Visual memory was also delineated into short and long-term visual memory. According to Hollingworth and Luck, visual short-term memory occurs when visual representations acquired from the environment are maintained and implemented by neural firing in the lateral occipital complex and prefrontal cortex for several seconds. Furthermore, visual short-term memory capacity was said to be limited to maintaining three or four simple visual stimuli, and one to two complex visual stimuli. On the other hand, visual long-term memory was described as having a greater storage capacity, and can maintain visual information about particular objects and scenes obtained via visual inputs. This complex sub-domain, can obtain, register, encode, incorporate and organize a vast amount of visual information regarding objects and scenes. These representations of the external environment are thought to be maintained by pattern and strength changes between neuronal connections, as well as changes in the structure of synaptic connections. Further, long-term memory, as well as executive functioning, can prevent comingling of visually obtained information helping to keep visual data organized into distinct categories.

Typically, visual information is thought to migrate through short-term memory prior to being encoded within the long-term memory (Atkinson & Shiffrin, 1968). However, interestingly enough, some more recent findings have shown that information may be encoded in long-term memory without passage through short-term memory. One hypothesis postulates that a visual long-term memory does not require passage through visual short-term memory, since the representation can be directly generated by the perceptual processes (Hollingworth & Luck, 2008).

Clearly, a great deal of work has been done within the field of research neuropsychology in the attempt to develop a working theoretical model of human visual memory. Similarly, within the clinical field of neuropsychology, these models have been utilized to develop many instruments to assess the many aspects of memory and, especially, visual memory. These include widely used instruments such as the Rey-Osterrieth Complex Figure Test (Ray-O; Osterrieth, 1944; Rey, 1941), the Brief Visual Memory Test (Benedict, Schretelen, Grondinger, Dobraski, & Shpritz, 1996) and the Visual Reproduction Subtests within the Wechsler Memory Scale - Third Edition (WMS-III; Wechsler, 1997b). However, as stated above, much like in the development of instruments for the assessment of other domains, neuropsychological methods of gathering normalization data for use with visual memory instruments leave gaps in which various ethnic groups are left underrepresented (Manly & Echemendia, 2007). In an attempt to remedy this shortcoming, as well as to better understand the neuropsychological consequences of HIV-1 on human memory functioning, the World Health Organization (WHO), in conjunction with the University of California, Los Angeles, developed the Picture Memory Interference Test (PMIT), for the assessment of visual memory, as part of a battery which was to be used to assess HIV patients from diverse ethnic backgrounds. This culturally neutral battery was administered to participants from various countries, including Brazil, Germany, Kenya, Thailand, the United States and Zaire (Maj et al., 1991). The development of culturally neutral instruments, such as the PMIT, is extremely important as is the development and implementation of proper normalization and standardization methods that will be more inclusive of ethnic groups.

### **The PMIT: Background and History**

The original version of this instrument was developed for manual administration. The pictures were printed on 3-by-5-inch cards, which were presented to the examinee, and

instructions were given verbally. The pictures, which were standardized on 219 psychology students by Snodgrass and Vanderwart's (1980), were used to develop the instrument due to their culturally neutral nature. Today, the instrument has been computerized giving rise to the Computerized Picture Memory Interference Test (CMIT). The original pictures are now presented to the examinee, with adjustable millisecond timing, using the Flash programming language for the Windows user interface (Franco, 2009).

### **The CMIT and What it Measures**

The PMIT is an instrument that was specifically developed to assess visual memory recognition and susceptibility to cognitive interference. In much the same way, the CMIT assesses the examinee's capacity to temporarily store visual information to memory and then to recall the information via four recognition trials. Further, in the fourth trial, the examinee is asked to match the picture being presented to the trial during which the image was initially presented. This more difficult trial assesses the patient's susceptibility to interference and cognitive comingling of visually obtained information and forces the examinee to utilize executive abilities as well as memory. This new instrument can, therefore, provide extremely specific information regarding a participant's or patient's memory functioning. The CMIT not only measures the ability to acquire, encode and recall visually obtained information (much like other instruments designed to assess visual memory) but can also provide information regarding whether the participant or patient is able to keep the visual information organized into non-thematic groups. The multicultural neutrality of the instrument which was established by using images of common objects observed in all countries and world regions (e.g., pictures of a hand, or a tree, etc.), in addition to the specific nature of the information the instrument provides regarding memory, makes the CMIT an extremely unique assessment tool. However, this

instrument, which is now internet-based and available to the masses, has yet to be validated and proven reliable for the, primarily Spanish-speaking, Latino population.

## **Validity**

The term *validity*, within the context of instrument construction, generally refers to the adequacy of an instrument to measure the cognitive or affective domain for which it was constructed to assess (Messick, 1980; Sireci, 1998). Due to the rigors of the scientific method, there has always been a general consensus that the validity of an instrument is not typically an inherent characteristic. Neuropsychologists developing psychometric instruments must establish the validity of an instrument prior to the clinical or scientific application of the instrument in question (Lissitz, 2009).

There are many different sub-types of validity, including content validity, face validity, discriminate validity, convergent validity as well as ecological validity.

Content validity is the term used to describe the ability of the instrument to capture the nature of the cognitive or affective domain being assessed. As an example, one might ask if the items within a depression scale truly reflect symptoms observed in depressed individuals (e.g., low mood, poor appetite, etc.). Unlike other aspects of validity, content validity has no validity coefficient (Barker, Pistrange, & Elliot, 2002).

Face validity is employed to assess whether or not the instrument looks as if it measures that which it was designed to measure. As in the example above, one might expect that the items within the depression scale ask specific questions regarding sadness, suicidality, poor sleep, etc. (Barker et al., 2002).

However, discriminate, convergent and ecological validity are the most pertinent when validating psychometric instruments involving cognitive domains such as visual memory

(DeVon et al., 2007). Discriminant validity is established by showing low correlation coefficients between theoretically differing constructs. For example, if a correlational study were conducted between scores from a visual memory test with those from a test of fine motor functioning, one would expect a low correlation coefficient between these scores since they differ theoretically. Convergent validity, on the other hand, is described as a similarity or convergence between two or more constructs that are theoretically similar (DeVon et al., 2007). In short, one would expect that scores from instruments measuring the same domain (e.g., visual memory) would show high correlation coefficients.

In addition to the above, it is widely accepted that neuropsychological instruments should not only produce valid results within controlled environments but should also do so within real-life settings (e.g., clinics, hospitals, etc.; Burgess, Alderman, Evans, Emslie, & Wilson, 1998). This is an aspect of validity referred to as ecological validity. For an instrument to be considered ecologically valid, the methods and setting in which the instrument is being assessed for ecological validity must mimic real-life circumstances and settings (Gioia, 2009).

## **Reliability**

Though validation of an instrument is important, establishing the reliability of an instrument is even more important. In fact, reliability is a necessary condition prior to establishing validity (Barker et al., 2002). Reliability refers to the consistency in the provision of an instrument's scores. As an example, a reliable measure of depression would consistently produce similar scores when administered to a chronically depressed individual whose symptoms remain unchanged over time. For the purposes of psychometrics, the validity of an instrument may be well established, however, an instrument that does not provide reliable scores does not allow for valid interpretation of its scores (Cook & Beckman, 2006). There are many ways to

establish an instrument's reliability including, test-retest methods, alternative form methods and the split-half method.

With the test-retest method, the same instrument is administered twice and a correlation coefficient is calculated between the scores of the primarily administered trial and the secondarily administered trial. As the correlation coefficient approaches 1, the instrument is deemed increasingly reliable. However, test-retest methods are often criticized due to confounds such as the practice effect. In fact, in many cases, such as when one is working with a secondary data set, test-retest methodology is not possible (DeVellis, 2012).

The alternate form method is very similar to the test retest methodology in that two different, but very similar, versions of the instrument are administered to the participants and a correlation coefficient is then calculated between the scores of the alternate forms. Again, as the correlation coefficient approaches 1 the instrument is considered increasingly reliable (DeVellis, 2012).

One method that is particularly useful in the field of psychometrics is the split-half method. With this method a correlational study is conducted between item scores from the top and bottom halves of the instrument. This method is especially appropriate to employ when test retest methodology is not possible (DeVellis, 2012). However, Cronbach's alpha is also a method often used in place of the split-half method and is deemed the gold standard when assessing internal reliability (Barker et al., 2002). Essentially, Cronbach's alpha (1) provides information regarding the overall correlations between items, (2) provides information regarding the correlations between each item on an individual basis, (3) can provide information regarding the effects on overall correlations if a specific item was to be deleted (DeVellis, 2012). These

specifics make Cronbach's alpha a superior method for assessing internal reliability of instruments such as the PMIT, as well as the CMIT.

### **The Reliability and Validity of Current Measures**

**The WMS-III, Visual Reproduction Subtests.** The WMS-III Visual Reproduction Subtests (Visual Reproduction I and Visual Reproduction II) are two of the most commonly used and well established instruments for the assessment of visual memory in regards to reliability and validity (Wechsler, 1997b). The Spanish adaptation of this instrument was developed in 1994 and proper normalization data was collected for the newly devolved instrument (Ardila, Rosselli, & Puente, 1994).

The administration of the Visual Reproduction I (VR I) involves showing the patient or participant five images. Each image is viewed at 10-second intervals after which the image is removed and the examinee is asked to reproduce the image from memory using paper and a pencil. After a 20- to 30-minute delay, during which other aspects of the WMS-III are administered, the Visual Reproduction II (VR II) is administered and the participant is asked to reproduce each image from memory using paper and a pencil. After the VR II phase, a recognition phase is also administered, during which the examinee is presented with multiple cards each of which contain images. Some of the images presented are those which the examinee was asked to reproduce and some are not. The examinee is asked to identify those images that he or she was asked to reproduce. The instrument is then scored using criteria provided by the WMS-III manual to reduce subjectivity of scoring.

**The Rey Auditory Verbal Learning Test.** The Rey Auditory Verbal Learning Test (RAVLT; Rey, 1964) has become a gold standard within the field for the assessment of verbal learning. This instrument is particularly sensitive to detecting deficits in verbal memory

functioning in participants infected with the HIV-1 Virus (Messinis, Taskona, Kollara, Malefaki, & Papathanasopoulos, 2007). The Spanish adaptation of this instrument was developed in 2002 and the validity, reliability and the internal consistency of this adaptation have been proven comparable to those of the English version (Neblina, 2012).

Administration of this instrument includes five acquisition trials of a list of 15 noun words, an interference trial of a list of 15 noun words, an after-interference recall trial during which the examinee is asked to recall words from the original 15 word list, a 30-minute delayed recall trial phase, during which the examinee is asked to recall as many of the words from the original list of 15 words as possible as well as a recognition phase during which the patient is presented with a list of 50 words, 30 of which are words from the original two lists presented and 20 of which are distracter words

**The WAIS-III.** The Wechsler Adult Intelligence Scale, third edition (WAIS-III; Wechsler, 1997a) is a comprehensive scale which provides general as well as very specific information regarding the intellectual and cognitive functioning of examinees (Kaufman, 2001). The original standardization sample consisted of 2,450 individuals between the ages of 16 and 89, with varying levels of education, who were administered the entire instrument which produced a full scale intelligence quotient (FSIQ), a verbal intelligence quotient (VIQ), a performance intelligence quotient (PIQ) as well as four indexes which include the verbal comprehension index (VCI), the working memory index (WMI), the perceptual organization index (POI) and the processing speed index (PSI).

The scores for all of the above are derived from the scores of 14 subscales which include the vocabulary subtest, during which the subject is presented with words and asked to define them; the similarities subtest, during which the subject is asked to discuss similarities between



two words; the information subtest, during which the subject is asked questions typically acquired in academic settings; the comprehension subtest, which assesses the subject's verbal comprehension; the arithmetic subtest, which requires the subject to do word problems without the use of pen or pencil; the digit span subtest, during which the subject is presented with strings of digits and asked to repeat; the letter-number sequencing subtest, during which the subject is presented with numbers and letters and asked to sequence each in order; the picture completion subtest, during which the patient is presented with pictures and asked to identify anomalies within each picture; the block design subtest, which is a three-dimensional reconstruction task; the matrix reasoning subtest, during which the subject is asked to identify patterns visually; the picture arrangement subtest, during which the subject is presented with pictures and asked to place them in order; the digit symbol-coding subtest, during which the subject is asked to match numbers with symbols using a key and the symbol search subtest during which the subject is asked to identify symbols within a small matrix (Kaufman & Lichtenberger, 1999).

The reliability of this instrument has been extensively vetted. For each subtest, both split-half as well as test-retest methodology was employed to assesses the instruments overall reliability. The results of the split-half and test-retest reliability assessments indicated that the FSIQ the PIQ and the VIQ each produced a correlation coefficient well above 90%. This was also true for the WAIS-III Indexes all of which produced correlation coefficients between 83-96% for both split-half as well as test-retest methods. At the subtest level, split-half and reliability correlation coefficients fall between 70-93%. These numbers are indicative of superior internal reliability for the WAIS-III. However, similar to many other instruments of its kind, the original normalization data was not stratified by ethnicity until the publication of the computerized scoring program (Kaufman & Lichtenberger, 1999).

Further, the data describing the validity of the WAIS-III was greatly improved from previous versions. Validity assessment indicated that the WAIS-III FSIQ produced a correlation coefficient of 64% with the Standard Progressive Matrices and a correlation coefficient of 88% with the Stanford-Binet, Fourth Edition. Additionally, construct validity was demonstrated using four-factor structural factor analysis. Overall, the WAIS-III is an extremely well vetted instrument. Additionally, the Spanish version of this instrument has shown equal psychometric validity and reliability as that of the English version (Renteria, Li, & Pliskin, 2008).

### **The Need for Culturally Appropriate Instruments**

Historically, researchers have universally maintained that cognitive processes manifest due to the functions of human neurobiology, (Perez-Arce, 1999). This is essentially a derivative of the nature aspect of the *nature vs. nurture* argument where cognitive processes are hypothesized to remain constant across cultures (Mindt, Byrd, Saez, & Manly, 2010). On the other hand, the nurture side of the argument (e.g., radical environmentalism) suggests that cognitive and neuropsychological processes are developed as the individual interacts with the environment (Nell, 2000). These two views have long-since been presented, and yet cultural and environmental factors on neuropsychological processes have not been studied sufficiently (Perez-Arce, 1999). Regardless, competent neuropsychological practice should include instruments, which assume that both culture and environment play a role in neuropsychological development, until this is definitively proven otherwise. Factors such as primary language, first language and cultural beliefs should always be taken into consideration during any neuropsychological assessment (APA, 2002).

In light of the above, the United States (U.S.) has seen profound demographic changes within the past few decades, primarily due to the excessive migration of non-English speaking

individuals into the country (Artiola, Fortuny, & Mullaney, 1998). The U.S. Census Bureau (2007) reported that the ethnic population, in general, has reached over 100 million, accounting for over one-third of the nation's population. Further, it is projected that the ethnic population, within the U.S., will reach close to 50% within the next 40 years (Mindt et al., 2010). These rapid increases within ethnic populations require the development of culturally appropriate and sensitive instruments that are normalized, standardized, validated and proven reliable for the assessment of ethnic cultures.

However, despite the rapid increases of various ethnic groups requiring mental health and neuropsychological services, there has been an inadequate response in offering culturally appropriate and sensitive services to ethnically diverse patients (APA, 2002). As a result of the rapidly changing demographics, the American Psychological Association has provided a mandate for clinicians and mental health professionals to provide culturally appropriate neuropsychological services. *The Ethical Principles of Psychologists and Code of Conduct* (APA, 2002) has provided principles for culturally appropriate neuropsychological services. Standard 9.06 states that the interpretation of neuropsychological test results must take into account factors such as “situational, personal, linguistic, and cultural differences, which might affect psychologist's judgments or reduce the accuracy of their interpretations” (APA, 2002, p.14).

Further, the Ethical Standard 9.02b states that, “Psychologists use assessment instruments whose validity and reliability have been established for use with members of the population tested” (APA, 2002, p. 13). As an example, the detection of a brain-based disorder (e.g., Dementia) depends largely upon the psychometric properties and characteristics of the

instrument being administered. Properties such as, standardized directions for administration, validity and reliability are especially important (Brickman, Cabo, & Manly, 2006).

### **Characteristics of the Population Under Study**

As stated above, there is little doubt that all U.S. non-Caucasian ethnic populations are projected to expand in the coming decades. However, one of the fastest growing ethnic populations is that of the Latino population. In 2010, the Latino population within the U.S. was 50.5 million making up 16% of the overall population. Within the last decade, the Latino population has grown by approximately 42%. This increase amounts to 15.2 million individuals (U.S. Census Bureau, 2007).

Further, within the state of California, Latinos makeup 36.6% of the total state population. Projections indicate that, by the year 2021, Latinos will be the largest ethnic population within the state (U.S. Census Bureau, 2007). Although the population is growing in number, sociodemographics do not indicate improvements in quality of life for this population. In 2010, approximately one-half of adult Latinos residing within California had less than a high school education. Further, over one-half of Latino immigrants, at the time, had yet to master the English language and were more likely to be medically uninsured when compared to other ethnic groups (Pew Hispanic Center, 2010).

### **Summary**

Neuropsychology has, without a doubt, become a front-runner among the many specialties offered to students of psychology (Stucky et al., 2010). Within this field, research neuropsychologists work to develop instruments for the assessment of various domains including memory, attention, language and visual spatial processing. Among the various instruments that have been developed, those assessing memory are by far the most widely used (Sander et al.,

2007). The development of these instruments has been based on years of research leading to various models for human memory functioning (e.g., Atkinson, & Shiffrin, 1968). However, the methods used to gather normalization data for use with these instruments, as well as the lack of validity and reliability studies with specific ethnic populations, leave a gap in which various ethnic groups are not properly represented.

The U.S. Census Bureau (2007) has projected dramatic growths in ethnic populations and these growths are predicted to be very prominent within Latino groups. In anticipation of these growths, the American Psychological Association (2002) published clear guidelines, for the assessment of ethnic groups using neuropsychological instruments. The American Psychological Association called for the use of appropriate normalization data as well as incorporation of factors such as primary language, place of birth and cultural background into the interpretation of neuropsychological data derived from assessment instruments. Therefore, the gathering of appropriate normalization data representing ethnic groups, as well as the development of culturally unbiased instruments, is becoming increasingly important.

The Picture Memory Interference Test is such a culturally unbiased instrument developed for the assessment of visual memory. The World Health Organization in conjunction with the University of California, Los Angeles, first developed it. This instrument was developed using the Snodgrass and Vanderwart (1980) standardized images that were placed on 3-by-5-inch cards and administered manually. This instrument was developed as part of a larger battery designed to assess HIV-1 positive patients residing within various countries around the world (Maj et al., 1991).

More recently, this instrument was computerized using the Flash programming language for the Windows operating system and was placed online for world wide access, giving rise to the

Computerized Memory Interference Test (CMIT; Franco, 2009). Though the Picture Memory Interference Test is considered a culturally unbiased, valid and reliable measure of visual memory, the newly developed CMIT is yet to be proven valid and reliable. In light of the projected demographic changes for the U.S., the purpose of this study is to establish the validity and reliability of the CMIT with a primarily Spanish-speaking population. It is the hope of the researcher to, not only make this instrument available for use with the Latino population, but to also shed light on the need for culture specific normalization data as well as validity and reliability studies with ethnic populations which will allow for proper representation of all ethnic groups for all neuropsychological assessment instruments.

## **Research Methods**

This section will describe the participants, the instruments used, detailed administration methods, procedures and data analysis methods.

### **Participants**

The overall sample size for this study was 127 Latino participants between the ages of 21 to 62 with a mean age of 44. These participants were primarily Spanish-speaking and the majority of this population had achieved an educational level between 10 to 12 years with a mean of 10.57 years of education. This sample also consisted of 99 males and 16 females with 12 individual who did not specify gender or were transgender. These demographics are illustrated in Table 1, Table 2 and Table 3.

### **Instruments**

**Administration of the CMIT.** The CMIT is a short and easily administered memory test that measures visual long-term memory and susceptibility to cognitive interference, (Maj et al., 1991). This instrument can be considered a well-developed and well-vetted direct test of visual memory, during which the examinee is asked to select between two previously presented visual stimuli (as stated above, visual stimuli consist of pictures of everyday objects).

The CMIT consists of five parts. Part A includes a brief demographic questionnaire, which takes approximately five minutes to complete. However, the CMIT also provides multiple questionnaires, which collect more detailed information about the examinee. Part B presents the examinee with a pre-test trial, which was designed to familiarize the examinee with the instrument. Part C presents the examinee with the target images to be memorized after which an immediate recall phase is administered. This includes three groups of images called books.

Part D includes a recall phase, which was designed to detect cognitive interference and cognitive comingling of images. Finally, Part E administers the reaction time portion of the test.

**Part A, the demographic questionnaire.** The CMIT has four questionnaires each of which enquires about a different aspect of the examinee's life. Examinees have the option of answering all or none of these questionnaires.

The instrument begins with part A, which informs the examinee of the four questionnaires and gives them the option to proceed with the questionnaires or to decline. If the examinee endorses "Yes" and hits the spacebar, the questionnaire is administered. If the examinee endorses "No" and hits the spacebar the questionnaire portion is bypassed.

The first questionnaire enquires about the examinee's origins. This questionnaire is called the "Origins Questionnaire", where the examinee is asked questions regarding, age, ethnicity, level of education, first language, etc.

The second questionnaire, called the "Past Questionnaire", gathers information about the examinee's history. Questions such as "Is this your first time performing the Computerized Memory Interference Test?" are presented. This portion of the instrument also enquires about a history of special education, loss of consciousness and handedness.

The third questionnaire, called the "Habits Questionnaire", enquires about the examinee's day-to-day life. Questions regarding frequency of caffeine use, tobacco use, and alcohol use are presented.

Finally the fourth questionnaire, called the "Today Questionnaire", enquires about the examinee's current state. This questionnaire may seem redundant, since it too enquires about caffeine, nicotine and alcohol use, however, it is important to note that the questions enquire



about use of these substances on the day of administration. Other questions include, “How do you feel mentally right now?” and “How much are you in love right now?”

**Part B, the pre-test trial.** The pre-test part of the instrument (Part B) was designed to familiarize the examinee with the instrument, especially in preparation for the post-test reaction time trial (discussed later). The instructions read “On your keyboard, with your index finger, press the right arrow key if the item is a square. Press the left arrow key if the item is not a square.” This section also informs the examinee that this portion of the instrument is timed and that the examinee should work as quickly as possible. During the administration of this portion 10 images are presented some of which are squares and some of which are circles. During the administration of these 10 items the examinee is to respond based on the formerly provided instructions.

**Part C, Book 1.** This portion of the instrument begins by stating, “You are going to be presented with some items that you need to remember. The items are things that exist in the real world.” Once the examinee presses the spacebar, the administration of this portion begins. Twenty images, which were adapted from the Snodgrass and Vanderwart (1980) study are presented at two-second intervals. These images were standardized and are pictures of objects that are commonly recognizable (e.g., a hand). After the 20 items are presented the Recall Group 1 portion is presented.

The instructions during the recall portion read “These were the items that you needed to remember. Now you are going to be presented with some more items. Some of the items will be the ones you just were presented with. Others will be new. You are to identify which items you remember from before.” The examinee is instructed to strike the left arrow if the item is new,

and the right arrow if he or she remembers seeing the image. Next, 50 images are presented to the examinee and he or she is instructed to respond based on the instructions provided above.

**Part C, Book 2.** The initial instructions for group 2 are identical to those of group 1. The examinee is simply instructed to observe and try to memorize the images. Also like group 1, 20 images are presented to the examinee at two-second intervals.

The examinee is then instructed to identify the images that they observed in the former presentation. The instructions for this portion are slightly different than those of group 1 in that they specifically instruct the examinee to identify images observed in group 2 only. Again, 50 items are presented to the examinee and the examinee is to respond based on the instructions provided for this section.

**Part C, Book 3.** Again, the initial instructions for this portion are identical to the initial instructions provided in the former two groups. The examinee is instructed, once again, to observe and memorize the images presented to him or her. Twenty items are presented at two-second intervals after which the examinee is to identify the images he or she observed from group 3 (and only group 3) among 50 images, which are presented to him or her. Next, the 50 items are presented and the examinee is to respond based on the instructions provided for this section.

**Part D, Book 4.** Part D of this instrument, in a way, combines the recall tasks of all the formerly presented recall tasks. The instructions read, “Now you are going to be presented with some more items. For each item you will need to identify which group the item came from. On your keypad and with your right index finger: Press the 1 key if they are from group 1, press the 2 key if they are from group 2, press the 3 key if they are from group 3, press the 0 key if they are not from group 1 or group 2 or group 3”. After the instructions are read and understood the

examinee is to hit the spacebar key to begin this portion. Once the spacebar is struck, 60 items are presented and the examinee is to respond according to the directions provided for this section. Again, this fourth book, more so than the first three, requires some executive abilities to avoid comingling of visually obtained information.

**Part E, Book 5 the reaction time test.** This portion of the instrument is a measure of one's reaction time. The initial instructions on the screen will read, "Now you are going to take a brief Reaction Time Test. On your Keyboard, with your index finger, press the right arrow key if the item is a square. Press the left arrow key if the item is not a square". The examinee is then instructed to place their index finger over the arrow keys and to hit space bar to begin.

Fifty images are then presented. Some of the images are square and some are circles. The respondent is to respond to each item in accordance with the instructions provided for this section. After all 50 items are presented and responded to the test is concluded.

**CMIT scoring.** For the computerized version of the PMIT, the computer automatically calculates the scores. For each book, a true positive and true negative score is provided. True positive scores are calculated based on the amount of times the respondent identified pictures that were initially presented to him or her during the target trial. True negative scores are derived from the number of times the respondent was able to avoid non-target images from interfering.

The computer also calculates false positive and false negative scores. False positive scores are calculated based on the number of times the responded endorsed an image that was not part of the target trial. False negative scores are calculated based on the number of times the respondent does not endorse an item that was part of the target trial. z-scores are calculated from the raw scores and are presented graphically for interpretation.

### **Administration of the WMS-III VR I and VR II**

As discussed in detail above, the WMS-III VR I and VR II are instruments that measure immediate and delayed visual recall. During VR I the five images are presented to the examinee for a period of 10 seconds and he or she is then asked to reproduce each image from memory. During VR II the five images are not presented and the examinee is asked to recall each of the five images from memory after a 20- to 30-minute delay. Next, the recognition phase is administered. The criteria provided by the WMS-III manual are used to score each of the drawings for both VR I and VR II and the raw scores are then converted to standard scores for interpretation.

### **Administration of the RAVLT**

As discussed above, the RAVLT is a verbal learning test consisting of seven subsections. Initially, a list of 15 words is presented to the examinee after which the examinee is asked to repeat the words in any order. This aspect of the instrument is repeated five different times. Next, a second list of 15 words is presented and the examinee is then asked to repeat the words in any order. This latter section is to assess susceptibility to cognitive interference (i.e., mixing up the words from the two lists). After a 20- to 30-minute delay, the examinee is then asked to repeat the words from the first list, which was presented to assess long-term memory. Finally, a recognition phase is administered. Raw scores are then converted to *z*-scores for interpretation.

### **Administration of the WAIS-III**

The WAIS-III is an instrument consisting of a battery of 14 subtests (as described above) each of which measures a specific cognitive ability. Kaufman and Lichtenberger (1999) described this instrument in detail. Out of these 14 subtests 10 are typically administered. These subtests include Picture Completion, Vocabulary, Digit-Symbol Coding, Similarities, Block Design,

Arithmetic, Matrix Reasoning, Digit Span, Information, Picture Arrangement, Comprehension, Symbol Search, Letter-Number Sequencing and Object Assembly.

During the Picture Completion Subtest, the patient or participant is presented with multiple pictures and asked to identify inconsistencies within each picture (e.g., an image may show a man brushing his teeth without a toothbrush in his hand). This subtest is one of three subtests, which assess visual organization skills.

The Vocabulary Subtest simply involves presenting the patient or participant with words and asking him or her to define the words. This particular subtest is considered the most reliable and valid assessment of verbal intelligence within the WAIS-III battery.

The Digit-Symbol Coding Subtests involves presenting the patient or participant with a page containing a key identifying numbers and corresponding symbols as well as a section below the key with boxes filled with digits and, below those, empty boxes. The patient or participant is asked to fill-in the corresponding symbols, from the key, within the empty boxes below the numbers provided below the key. The patient or participant is given 120 seconds to complete as much of this subtest as possible. This particular subtest is a measure of visual scanning and processing speed.

The Similarities Subtest involves presenting the patient or participant with two words (e.g., tulip and rose) and asking him or her to identify similarities between the two words (e.g., both flowers). During this subtest one point is given for *concrete* responses (e.g., a tulip and a rose are both colorful) and two points are given for *abstract* responses (e.g., a tulip and a rose are both flowers).

The Block Design Subtest is a measure of visual constructions. For this subtest the patient or participant is given six blocks and presented with images on a page. The patient or

participant is, then, asked to recreate the image presented using the six blocks. As the administration progresses, the examinee is then given nine blocks making the subtest more difficult. The patient or participant is rewarded with more points the faster he or she is able to complete each item.

The Arithmetic Subtest involves verbally presenting the patient or participant with arithmetic word problems and asking him or her to solve the problem without the use of pen or paper. As the administration progresses the word problems become increasingly difficult (and longer). This subtest is primarily a measure of working memory.

The Matrix-Reasoning Subtest involves presenting the patient or participant with a matrix containing shapes placed in a specific pattern. The patient or participant is then asked to complete the pattern by choosing the next appropriate shape within the matrix from a pool of five shapes. This subtest is a measure of visual organization and abstract thinking ability.

The Digit-Span Subtest is a measure of working memory and presents the patient or participant with strings of digits. He or she is then asked to repeat the digits in the same order as they were presented. The strings of digits presented become increasingly longer as the administration progresses. Each item offers two points to be earned. The subtest is discontinued when the patient or participant is unable to earn any points within any one item.

The Information Subtest involves asking the patient or participant questions they would have learned in academic settings (e.g., Who was Abraham Lincoln?). This subtest measures crystallized knowledge and verbal abilities.

The Picture Arrangement Subtest presents the patient or participant with images, which, if placed in the correct order depict an event from beginning to end (e.g., a man painting a

home). This is done using cards with the images printed on each. The picture arrangement subtest is a measure of perceptual organization.

The Comprehension Subtest involves asking the patient or participant questions (e.g., Why do we require police officers to wear badges?). The patient or participant receives one point for each question answered correctly. This subtest is primarily a measure of verbal comprehension.

During the Symbol Search Subtest the patient or participant is presented with multiple pages (one at a time) each of which has two target symbols adjacent to a small matrix of other symbols. He or she is then asked to identify one of the two target symbols within the small matrix of other symbols (only one of the two target symbols will be present within the matrix, if any). If the patient or participant is able to identify one of the target symbols within the small matrix he or she is instructed to draw a line through the symbol within the small matrix using a pencil. If neither target symbols are present within the small matrix the patient or participant is instructed to draw a line through a “NO” box, which is also provided, indicating that no target symbols were detected within the small matrix. The patient or participant is given 120 seconds to complete as much of this subtest as possible. The symbol search subtest is primarily a measure of processing speed.

The Letter-Number Sequencing Subtest is similar to the Digit Span Subtest in that the patient or participant is presented with a string of digits and letters. The patient or participant is then asked to sequence the numbers and letters in order (numbers first, then letters). This subtest, too, is a measure of working memory.

Finally, the Object Assembly Subtest is a measure of perceptual organization and presents the patient or participant with increasingly difficult but small jigsaw puzzles (e.g., asks the patient or participant to assemble a cut-up Rhinoceros).

As stated above, during a standard administration of the WAIS-III, 10 of the 14 subtests are typically administered. The final four subtests are typically reserved and used as proxy subtests in case one of the first 10 subtests is deemed inappropriate for a particular patient or participant or is invalid or uninterpretable. Raw scores from the subtests are converted to scale scores for each subtest and, in turn, to standard scores for each index and the FSIQ.

Administration of the WAIS-III typically takes an experienced examiner 45- to 60-minutes.

### **Procedures & Data Analysis**

The study will be divided into six phases: (a) The first phase will involve assessing all the data for proper distribution, and homogeneity of variance for parametric analysis, (b) the second phase will involve using the control group data and correlating the CMIT scores with those of the WMS-III VR I and VR II, (c) the third phase will involve using the control group data and correlating the CMIT scores with those of the RAVLT, (d) the fourth phase will involve using the control group data and correlating the CMIT scores with those of the WAIS-III Block Design, Matrix Reasoning and Vocabulary subtest, (e) the fifth phase will involve comparing the CMIT scores of the participants from the control group to those of the treatment group. Finally, (f) the Cronbach's Alpha statistical method will be use for the analysis of internal reliability.

#### **Phase A, B, C & D: Correlation between CMIT scores and WMS-III VR I and VR II, RAVLT and the three WAIS-III subtest scores collected for the control group.**

Initially, the data collected for each subtest from each instrument will be assessed for skewness and kurtosis as well as for homogeneity of variance (Kim, 2013). As stated above, when



attempting to establish the validity of a newly developed instrument, it is not uncommon to first attempt to establish convergent validity. One aspect of this study, attempts to correlate the CMIT control group scores (i.e., scores from individuals not identified as exhibiting cognitive deficits due to HIV-1) with those of the WMS-III VR I and VR II control group scores using the Pearson correlation method to determine linear correlations between the scores (Spearman correlations will be used for data with anomalous distribution patterns as needed). Since both the CMIT and the WMS-III VR I and VR II are measures of visual memory, it makes sense to use the VR I and II to establish convergent validity for the CMIT.

Further, to establish discriminant validity, during phase (c) the CMIT control group scores will be correlated with those of the RAVLT control group scores, again, using the Pearson correlation method (again, Spearman correlations will be used for data with anomalous distribution patterns as needed). Since the CMIT is an instrument that measures visual learning and memory, and tests a completely different domain than that of the RAVLT, it is hypothesized that statistically significant correlations will not exist between the scores obtained from these two instruments.

Similarly, phase (d) will be used to detect correlations between the control group scores from the three selected WAIS-III subtests and CMIT control group scores using the Pearson or Spearman correlation method. It is hypothesized that statistically significant correlations will not be observed between the CMIT scores and the WAIS-III subtest scores since the three selected subtests do not involve memory.

**Phase E.** Phase (e) will serve to establish construct validity and reliability. Since individuals who have been diagnosed as HIV associated neurocognitive disorder (HAND) tend to show difficulties with memory tasks, CMIT scores from the control group will be compared to

those of the treatment group (HAND group). This will be accomplished by using a One-way Analysis of Variance (ANOVA). If a statistically significant difference is found between these two groups, this will show that the CMIT is well constructed and can detect deficits in visual memory.

**Phase F.** During this final phase, the internal reliability of the instrument will be established by employing Cronbach's Alpha. Overall correlations and inter-item correlations will be calculated as well as the effects on the overall correlations if specific items are deleted. The Statistical Packages for the Social Science's version 19 (SPSS 19) will be used during all analyses in this study.

### **Importance and Purpose of Study**

The determination of the discriminant validity, convergent validity and internal reliability of the CMIT is important for several reasons. First, the validation of this instrument will bring this instrument one step closer for use with Spanish-speaking patients and participants and will add to the multicultural neuropsychological literature. Second, if the CMIT were proven to be invalid or unreliable, the knowledge of this would prevent neuropsychologists from using the instrument and, in turn, misdiagnosing a patient. Finally, the publication of this dissertation may encourage further research and, perhaps, motivate replication of this study with populations from a wide range of linguistic and cultural backgrounds.

Therefore, the purpose of this dissertation is to (1) determine the convergent validity of the CMIT with primary Spanish-speaking individuals, (2) to determine the discriminant validity of the CMIT for primary Spanish-speaking individuals and (3) to determine the internal reliability of the CMIT with primarily Spanish-speaking individuals. This investigation seeks to answer the following research questions:

1. Is there a statistically significant correlation between CMIT scores and WMS-III VR I and VR II scores collected for a primarily Spanish-speaking sample of healthy individuals?
2. Is there a statistically significant correlation between CMIT scores and RAVLT scores collected from a primarily Spanish-speaking sample of healthy individuals?
3. Is there a statistically significant correlation between CMIT scores and the three WAIS-III subtest scores collected from a primarily Spanish-speaking sample of healthy individuals?
4. Is there a statistically significant difference between CMIT scores collected from individuals who exhibited cognitive deficits due to HIV-1 and those from individuals who did not exhibit cognitive deficits within a primarily Spanish-speaking sample of individuals?
5. Is there a statistically significant correlation between CMIT items internally?

**Hypothesis 1.** There will be a statistically significant correlation found between the CMIT scores and the WMS-III VR I and VR II scores collected from a primarily Spanish-speaking sample of healthy individuals.

**Hypothesis 2.** There will not be a statistically significant correlation found between the CMIT scores and the RAVLT scores collected from a primarily Spanish-speaking sample of healthy individuals.

**Hypothesis 3.** The three selected WAIS-III subtest scores (Matrix Reasoning, Vocabulary and Block Design subtests) which do not involve visual memory, will not correlate at a statistically significant level with CMIT scores collected from a primarily Spanish-speaking sample of healthy individuals.

**Hypothesis 4.** There will be a statistically significant difference found between the mean CMIT scores collected from HIV-1 positive individuals whom exhibit cognitive deficits (known group) and those individuals without cognitive deficits within a sample of primarily Spanish-speaking individuals.

**Hypothesis 5.** There will be statistically significant correlations between the items of the CMIT internally.

## Results

### Correlations

Two correlational studies were conducted between the CMIT scores and those of the other instruments. The Spearman's statistic was used to study the CMIT Books 1 and 5. Spearman's *rho* was used due to anomalies observed within the distribution of these variables illustrated in Table 4.

### Correlations between the CMIT and the WMS-III VR I, VR II

A Spearman's correlational study did not indicate a strong relationship between the scores obtained from the CMIT Book 1 and those obtained from the WMS-III Visual Reproduction I,  $r(76)=-.010, p=.933$ , and Visual Reproduction II,  $r(76)=-.029, p=.804$ . Pearson Correlational studies indicated statistically significant relationships between the PMIT Book 2 and the WMS-III Visual Reproduction I,  $r(76)=.353, p=.002$ , as well as Visual Reproduction II,  $r(76)=.537, p<.001$ . Statistically significant correlations were also observed between the CMIT Book 3 and the WMS-III Visual Reproduction I,  $r(76)=.299, p=.008$ , and the WMS-III Visual Reproduction II,  $r(76)=.421, p<.001$ , the CMIT Book 4 and the WMS-III Visual Reproduction I,  $r(75)=.285, p=.012$ , and the WMS-III Visual reproduction II,  $r(75)=.322, p=.004$ , as well as the CMIT Total Score and the WMS-III Visual Reproduction I,  $r(75)=.349, r=.002$ , and the WMS-III Visual Reproduction II,  $r(75)=.459, p<.001$ . These results are illustrated in Table 5.

### Correlations between the CMIT and the RAVLT

Statistically non-significant correlations were observed between the CMIT Book 1 and the RAVLT Trial 1,  $r(76)=.018, p=.874$ , the RAVLT Trail 2,  $r(76)=-.186, p=.102$ , the RAVLT Trial 3,  $r(76)=-.145, p=.206$ , the RAVLT Trail 4,  $r(76)=-.089, p=.436$ , the RAVLT Trail 5,  $r(76)=-.029, p=.798$ , the RAVLT Total Score,  $r(75)=-.110, p=.339$ , the RAVLT List B,  $r(76)=-$

.046,  $p=.692$ , the RAVLT Short Delay,  $r(76)=-.066$ ,  $p=.564$ , the RAVLT Long Delay,  $r(76)=-.026$ ,  $p=.823$ , and the RAVLT Recognition Trail,  $r(76)=.004$ ,  $p=.972$ .

Statistically non-significant results were also observed between the CMIT Book 2 and the RAVLT Trial 1,  $r(76)=-.047$ ,  $p=.683$ , the RAVLT Trial 2,  $r(76)=.166$ ,  $p=.147$ , the RAVLT Trail 3,  $r(76)=.212$ ,  $p=.062$ , the RAVLT Trail 4,  $r(76)=.193$ ,  $p=.091$ , the RAVLT Trail 5,  $r(76)=.210$ ,  $p=.065$ , the RAVLT Total Score,  $r(75)=.214$ ,  $p=.062$ , the RAVLT List B,  $r(76)=.061$ ,  $p=.596$ , the RAVLT Short Delay,  $r(76)=.169$ ,  $p=.138$  and the RAVLT Recognition,  $r(76)=.191$ ,  $p=.094$ . A statistically significant correlation was observed between the CMIT Book 2 score and the RAVLT Long Delay,  $r(76)=.254$ ,  $p=.025$ .

Statistically non-significant results were observed between the CMIT Book 3 and the RAVLT Trail 1,  $r(76)=-.024$ ,  $p=.833$ , the RAVLT Trail 2,  $r(76)=.099$ ,  $p=.391$ , the RAVLT Trail 3,  $r(76)=.182$ ,  $p=.110$ , the RAVLT Trail 4,  $r(76)=.153$ ,  $p=.180$ , the RAVLT Trail 5,  $r(76)=.195$ ,  $p=.088$ , the RAVLT Total Score,  $r(75)=.175$ ,  $p=.128$ , the RAVLT List B,  $r(76)=.216$ ,  $p=.057$ , the RAVLT Short Delay,  $r(76)=.090$ ,  $p=.434$ , and the RAVLT Recognition,  $r(76)=.204$ ,  $p=.073$ . A statistically significant correlation was observed between the CMIT Book 3 and the RAVLT Long Delay,  $r(76)=.241$ ,  $p=.033$ .

The CMIT Book 4 did not correlate strongly with the RAVLT Trail 1,  $r(75)=.076$ ,  $p=.509$ , the RAVLT Trail 2,  $r(75)=.145$ ,  $p=.208$ , The RAVLT Trial 3,  $r(75)=.212$ ,  $p=.065$ , the RAVLT Trail 4,  $r(75)=.220$ ,  $p=.054$ , the RAVLT Trail 5,  $r(75)=.190$ ,  $p=.099$ , the RAVLT List B,  $r(75)=.084$ ,  $p=.468$ , the RAVLT Short Delay,  $r(75)=.218$ ,  $p=.057$ , the RAVLT Long Delay,  $r(75)=.208$ ,  $p=.070$ , and the RAVLT Recognition Trail,  $r(75)=.135$ ,  $p=.241$ . A statistically significant correlation was observed between the CMIT Book 4 and the RAVLT Total Score,  $r(74)=.236$ ,  $p=.040$ .

Statistically non-significant correlations were also observed between the CMIT Book 5 and the RAVLT Trial 1  $r(75)=.085, p=.465$ , the RAVLT Trial 2,  $r(75)=.208, p=.070$ , the RAVLE Trail 3,  $r(75)=.166, p=.149$ , the RAVLT Trail 4,  $r(75)=.186, p=.106$ , the RAVLT Trail 5,  $r(75)=.128, p=.268$ , the RAVLT Total Score,  $r(74)=.221, p=.055$ , the RAVLT List B,  $r(75)=.139, p=.228$ , The RAVLT short Delay,  $r(75)=.196, p=.087$  and the RAVLT Recognition Trail,  $r(75)=.044, p=.695$ . A statistically significant correlation was observed between the RAVLT Long Delay and CMIT Book 5,  $r(75)=.356, p=.001$ .

Finally, the CMIT Total Scores correlated at a statistically significant level with the RAVLT Trail 3,  $r(75)=.245, p=.032$ , the RAVLT Trail 4,  $r(75)=.239, p=.037$ , the RAVLT 5,  $r(75)=.251, p=.028$ , the RAVLT Total Score,  $r(74)=.270, p=.019$ , the RAVLT Short Delay,  $r(75)=.225, p<.049$ , and the RAVLT Long Delay,  $r(75)=.302, p=.008$ . The RAVLT Trail 1,  $r(75)=.033, p=.774$ , Trail 2,  $r(75)=.191, p=.097$ , List B,  $r(75)=.149, p=.196$ , and the Recognition Trail,  $r(75)=.213, p=.063$ , did not correlate at a statistically significant level with the PMIT Total Score. These results are illustrated in Table 5.

### **Correlations between the CMIT subtests and the WAIS-III**

A Pearson correlation study was also conducted between the CMIT scores for Books 2, 3, 4 as well as the CMIT Total Score and three of the WAIS-III subtests (Block Design, Matrix Reasoning and Vocabulary subtests). The results of these studies indicated a statistically non-significant correlation between the CMIT scores for Book 1 and the WAIS-III Block Design Subtest,  $r(76)=.015, p=.895$ , the WAIS-III Matrix Reasoning Subtest,  $r(76)=.030, p=.792$  and the WAIS-III Vocabulary Subtest,  $r(76)=.025, p=.830$ . Statistically significant correlations were observed between the CMIT Book 2 and the WAIS-III Block Design Subtest,  $r(76)=.334, p=.003$ , the WAIS-III Matrix Reasoning Subtest,  $r(76)=.225, p=.047$  and the WAIS-III

Vocabulary Subtest,  $r(76)=.337, p=.003$ . Correlations observed between the CMIT Book 3 and the WAIS-III Block Design Subtest were also statistically significant,  $r(76)=.378, p=.001$ , as were correlations between the WAIS-III Matrix Reasoning Subtest,  $r(76)=.253, p=.025$  and the WAIS-III Vocabulary Subtest,  $r(76)=.381, p=.001$ . Similarly, statistically significant correlations were observed between the CMIT Book 4 and the WAIS-III Block Design Subtest,  $r(76)=.318, p=.005$ , the WAIS-III Matrix Reasoning Subtest,  $r(76)=.251, p=.027$  and the WAIS-III Vocabulary subtest,  $r(75)=.385, p=.001$ . Observations made between the CMIT Book 5 and the three WAIS-III subtests indicated statistically non-significant correlations between the CMIT Book 5 and the WAIS-III Block Design Subtest,  $r(76)=.219, p=.056$ , and the WAIS-III Matrix Reasoning Subtest,  $r(76)=.153, p=.184$ . Correlations between the WAIS-III Vocabulary Subtest and the CMIT Book 5 were statistically significant,  $r(75)=.275, p=.016$ .

Finally, Statistically significant correlations were observed between the CMIT Total Score and the WAIS-III Block Design Subtest,  $r(75)=.366, p=.001$ , the WAIS-III Matrix Reasoning subtest,  $r(75)=.267, p=.019$  and the WAIS-III Vocabulary Subtest,  $r(75)=.438, p<.001$ . These results are illustrated in Table 5.

### **ANOVA Between Individuals With and Without HAND**

A univariate ANOVA was used to assess known-group validity by comparing the CMIT scores between individuals without HAND and those with HAND. As shown in Table 6, individuals without HAND generally scored significantly higher on the CMIT subtests compared to individuals with HAND. Specifically, individuals without HAND scored significantly higher on CMIT Book 1, CMIT Book 2, CMIT Book 3, CMIT Book 4, and the CMIT Total Scores ( $p<.02$ ). In contrast, no statistically significant difference was observed between the average scores of individuals with and without HAND on CMIT Book 5 ( $p=.285$ ).



### **CMIT Internal Consistency**

In order to assess the reliability of the scale, Cronbach's coefficient *alpha*, was calculated. As stated above, Cronbach's coefficient *alpha* ( $\alpha$ ) is a measure of overall scale reliability in which average correlations among items are evaluated to provide an estimate of the internal consistency. A Cronbach's *alpha* reliability statistic of .70 is considered as the minimum value for adequate internal consistency (Kline, 2000). In addition, the Cronbach's *alpha* if item deleted index was evaluated to determine if the reliability could be improved through removal of individual scales (i.e., books) from the CMIT measure. The alpha coefficient obtained for the five scales of the CMIT was .768. The reliability of this scale is acceptable for purposes of basic early stage research because it exceeds the standard considered to be satisfactory for such purposes (.70).

In order to determine if the reliability of the scale could be improved through exclusion of any of the five CMIT scales, the Cronbach's  $\alpha$  if item deleted index was examined. The Cronbach's  $\alpha$  if item deleted index specifies the value of  $\alpha$  if that specific item were removed from the scale. Since  $\alpha$  for the original five-scale version of the CMIT is .768, any items with an  $\alpha$  if item removed value greater than .768 are detracting from the reliability of the measure. As shown in Table 7, the  $\alpha$  if item deleted of CMIT Book 5 indicated that the reliability of the scale would be improved if it were excluded from the total measure score, increasing from .768 to .808. It important to note that a reliability of .808 is desirable as it exceeds the .80 criterion necessary to conduct research involving comparison between groups.

## **Discussion**

### **Hypothesis One**

In regards to the first hypothesis, statistically significant correlations were observed between the WMS Visual Reproduction subtests and four out of six of the CMIT scores, including the CMIT Total Score. Books 1 and 5 did not correlate with the WMS Visual Reproduction scores at a statistically significant level. The lack of a statistically significant correlation observed between the WMS subtests and Book 5 was not surprising since Book 5 is a test of reaction time with scores measured in total correct responses. However, the lack of a correlation between the WMS subtests and Book 1 was surprising.

Upon further examination of the nature of the two instruments, Book 1 of the CMIT is the least challenging of the instrument's subtest as it does not require that the examinee decipher between images observed within Book 1 and the other books. It would, therefore, make sense why there might be a lesser correlation between this initial CMIT book and the WMS subtests since the level of difficulty for the WMS subtests remain consistent, and relatively difficult, throughout the administration. As the CMIT progresses, however, the examinee begins to be asked to decipher between images observed within the current book as well as former books. Therefore, the memory task becomes increasingly difficult as the administration progresses. One can postulate, then, that as the administration of the CMIT progresses, scores begin to more closely match the more difficult WMS tasks causing the correlation coefficient to increase.

Book 1 was also the only non-normally distributed variable showing a skewed and leptokurtic distribution as well as a lack of homogeneity of variance. Therefore, non-parametric correlational statistics were used for this book (Bishara & Hittner, 2012). However, statistically

significant correlations were still not observed between this book and the other WMS subtests post the application of non-parametric methods.

It is important to note here that due to the fact that the CMIT total scores, which are produced after a typical administration, include true negatives; true negative responses were also included in this study as correct responses. Given the correlations observed between the other three books of the CMIT and the WMS subtests, convergent validity of the CMIT can be considered confirmed in this case.

## **Hypothesis Two**

It was hypothesized that the RAVLT scores would not show statistically significant correlations with the CMIT scores given that the two instruments assess two separate domains of memory. This was shown to be true to some degree. Very few correlations were observed between the RAVLT trials and the CMIT Books 1 through 4. However, six out of the 10 correlations conducted between the CMIT Total Scores (which, again, include true negatives) and the RAVLT subtests showed statistically significant levels of correlation.

Similar to the results observed with the WMS, these results may be due to the fact that the two instruments begin at differing levels of difficulty. The RAVLT begins with a list of 15 words and over the course of five separate learning trials becomes a much easier memory task by the fifth trial due to repetition, rehearsal and learning. Recent studies have corroborated this showing that increased and over-rehearsal strategies employed by certain examinees increased performance on the RAVLT dramatically (Bowler, Limoges, & Mottron, 2009; Hessen, 2011). It, therefore, makes sense that the scores from the two instruments would become increasingly similar as the RAVLT progresses, with the greatest number of correlations observed between the

CMIT books and the RAVLT total score. Essentially, the RAVLT begins as an extremely difficult memory-demanding task, but becomes easier with the advent of rehearsal.

In regards to why the visual memory instrument (the CMIT) and the verbal memory instrument (the RAVLT) show any correlations at all, given they assess two different domains of memory; studies have also shown that these two memory domains are not so dissimilar and the observation of correlations between them are not uncommon. Park, Lautenschlager, Hedden, Davidson and Smith (2002) have demonstrated significant correlations between these two memory domains across the life-span with similar levels of decline in older aged adults. Giambra, Arenberg, Zonderman, Kawas and Costa (1995) also found similar results in this regard. Given these results, discriminant validity of the CMIT cannot be considered as confirmed in this case.

### **Hypothesis Three**

It was hypothesized that the CMIT scores would not correlate with the three WAIS Subtests (i.e., Block Design, Matrix Reasoning and Vocabulary). Surprisingly, many of the CMIT scores correlated significantly with the scores from the WAIS subtests including the CMIT Total Scores. The discriminate validity of the CMIT was, therefore, not established in this case.

These findings are surprising due to the fact that the WAIS subtests, which were used, were not designed to assess memory functioning. It was postulated, therefore, that these instruments would serve the researcher well in establishing discriminant validity via correlational studies.

In retrospect, two of these instruments, namely the Block Design and Matrix Reasoning, are also demanding of executive abilities since they both require a certain level of visual spatial

reasoning (Friedman et al., 2006). As stated above, Books 2, 3, and especially 4 of the CMIT also force the examinee to utilize executive abilities to prevent comingling of visual information. In light of this, it makes some sense that these two WAIS subtests, which were used, would correlate with Books 2, 3, 4 and, in turn, the CMIT Total Score. This is especially true since true negatives were included as correct answers and it is these true negative scores that represent the executive ability to keep the visual information organized.

In this case, it can be stated that the requirement of executive abilities by these two instruments acted as a confound and could very well have caused the strong correlations observed between the WAIS Block Design and Matrix Reasoning and the CMIT Books 2, 3, 4 and Total Score. The fact that Book 1 of the CMIT did not correlate with any of the WAIS instruments corroborates this idea since this book requires virtually no amount of executive ability.

As for the Vocabulary Subtest from the WAIS, this too showed strong correlations with the CMIT Books 2, 3, 4, and in turn, the Totals Score. This subtest of the WAIS has also been shown to correlate at a statistically significant level with various measures of executive functioning (Friedman et al., 2006). Further, as stated above, research has shown that visual memory and verbal memory are strongly interrelated (Giambra et al., 1995; Park et al., 2002). It, therefore, makes sense that a subtest that requires some verbal memory, such as the WAIS Vocabulary subtest, might correlate, to some degree, with a measure of visual memory such as the CMIT.

#### **Hypothesis Four**

As hypothesized, statistically significant differences were observed between the HAND diagnosed group and the non-HAND diagnosed group, with the non-HAND diagnosed group

scoring consistently higher. Further, the fifth portion of the instrument, a test of reaction time which recorded correct and incorrect answers, was the only variable for which statistically significant differences were not observed. As stated above, since the HAND diagnosed group was known to have memory deficits, these results demonstrate that the CMIT is sensitive to detection of visual memory deficits.

### **Hypothesis Five**

To assess internal reliability, Cronbach's  $\alpha$  statistic was used. The results indicated that the internal consistency of the CMIT was sufficiently established. Further, the results indicated that if the fifth portions of the CMIT, which assess reaction time, were deleted, the internal consistency of the CMIT would be greatly improved. These results suggest a strong level of internal consistency among the items.

### **Limitations and Implications for Further Research**

In retrospect, several issues must be addressed with this study. First, it would seem that, according to the literature, it was unwise to use a measure of verbal memory (i.e., the RAVLT) to establish discriminant validity as the domain of visuospatial memory and verbal memory have proven to be interrelated (Giambra et al., 1995; Park et al., 2002). Recommendations for further research include using instruments such as the WAIS Digit Span, Arithmetic or Letter-number Sequencing subtests which are designed to assess working memory which is further removed from the domain of visuospatial memory than is verbal memory. As an example, Bagby, Graeme, James and Parker (1994) used such instruments as the Psychological Mindedness Scale (PMS) to assess the discriminant validity of the Toronto Alexithymia Scale (TAS-20), which is a measure of one's ability to describe or understand one's emotional status. In this case, the researchers used an instrument which assessed a domain of emotional and cognitive functioning

that was virtually opposite of those of the TAS-20. As a result, the scores were found to be negatively correlated and provided sufficient evidence for discriminant validity.

Second, though some seemingly dissimilar measures were used (i.e., the WAIS subtests), these instruments still shared a common variable in that they all required either verbal memory or executive functioning abilities that seem to have served as confounds. This too, should have been avoided. Subtests from the WAIS such as the Digit Span, Arithmetic or Letter-Number Sequencing may have better served the purpose of establishing discriminant validity. The establishment of discriminant validity of such instruments as the CMIT is difficult given that multiple domains are required to complete the task successfully. The instruments employed within a research design of this kind, for the purpose of establishing discriminant validity, should be well vetted.

Finally, the known-group method used in hypothesis four which was employed to establish reliability seemed to serve this study well as the researcher failed to reject this hypothesis. Further, the statistical methods used to test hypothesis five (Cronbach's  $\alpha$ ) was also effective in establishing internal reliability and consistency. The latter two statistical methods, therefore, are recommended in future studies of this kind.

### **Final Comments**

To date, the neuropsychological and psychometric literature indicates a lack of ethnic-specific normalization data and instruments that are shown to be valid and reliable for use with many ethnic groups (e.g., Benedict et al., 2012). Recent studies have also shown that an individual's cultural background can have profound effects on the individuals performance on many neuropsychological and psychometric instruments when proper instruments and normalization data are not used (Silverberg, Hanks, & Tomkins, 2013). It is the hope of the

researcher that this study has emphasized the importance of establishing instruments, such as the CMIT, valid and reliable for use with specific ethnic groups, and to encourage researchers to continue efforts in collecting culture specific normalization data as required by the American Psychological Association (2002).



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## APPENDIX A

### Summary of Literature Review

## Appendix A

### Summary of Literature Review

#### Introduction

Author/ Year	Research Question s/ Objective s	Sample	Variables/ Instrumen ts	Research Approach/D esign	Major Findings
Manly, J. J., & Echem ndia, R. J. (2007). Race- specific norms: Using the model of hyperten sion to understa nd issues of race, culture, and educatio n in neuropsy chology. <i>Archives of Clinical Neurops ychology</i> , 22, 319-325. <a href="http://dx.doi.org/10.1016/j.acn.2007.01.006">http://dx. doi.org/1 0.1016/j. acn.2007 .01.006</a>	What are the challenge s in obtaining neuropsyc hological normaliza tion data for Ethnic populatio ns?	N/A	N/A	Theoretical	In this paper it is reported that (1) race-specific norms ignore underlying cultural and educational factors, (2) Set more lenient cutoffs for impairment. Hypertension is used as a model or analog for neuropsychology.



Sander, A. M., Nakase-Richardson, R., Constantino, F., Wertheimer, J., & Paul, D. R. (2007). Memory assessment on an interdisciplinary rehabilitation team: A theoretically based framework. <i>American Journal of Speech-Language Pathology</i> , 16, 316-330. <a href="http://dx.doi.org/10.1044/1058-0360(2007/036)">http://dx.doi.org/10.1044/1058-0360(2007/036)</a>	The paper delineates a cognitive neuroscience model of memory and promotes use of consistent terminology in interdisciplinary discussions.	N/A	N/A	Theoretical	The author describes a theoretically based model of memory that is more readily understandable by interdisciplinary teams. The authors also discuss the history of the development of memory models starting with Shiffrin (1968), through Hitchcock's (1974) works on working memory, to Baddeley's (2000) works on episodic memory. Long-term memory is described as composing of declarative memory, and episodic memory. Nondeclarative memory is described as being a function of priming and procedural learning (habits).
Stucky, K. J., Bush, S., &	Should there be a more clear	N/A	N/A	Theoretical	The authors develop a clear framework for providing neuropsychologist with

Donders, J. (2010). Providing effective supervision in clinical neuropsychology. <i>Clinical Neuropsychology</i> , 24(5), 737-758. <a href="http://dx.doi.org/10.1080/13854046.2010.490788">http://dx.doi.org/10.1080/13854046.2010.490788</a>	framework for training neuropsychology trainees?				clear guidelines to take supervisory roles. Much like Falander and Shafranske (2004) a competency-based approach to supervision that advocates for science-informed, formal and goal oriented structure to supervision.
Wasserman, J. D., & Lawhorn, R. M. (2003). Nonverbal neuropsychological assessment. In R. S. McCallum (Ed.), <i>Handbook of nonverbal assessment</i> (pp. 23-50). New	book describing aspects of nonverbal neuropsychological assessment.	N/A	N/A	Theoretical	Nonverbal cognitive abilities are operationalized. A variety of nonverbal instruments across all neuropsychological domains (e.g., attention, memory, etc.) are all described.

York, NY: Kluwer Academi c/Plenu m.					
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## Memory Defined

Author/ Year	Research Questions/ Objectives	Sample	Variables/ Instrumen ts	Research Approach/D esign	Major Findings
Baddeley, A. D. (1986). Short-term memory for word sequences as a function of acoustic semantic and formal similarity. <i>Quarterly Journal of Experimental Psychology</i> , 38, 527-533. <a href="http://dx.doi.org/10.1080/14640746608400055">http://dx.doi.org/10.1080/14640746608400055</a>	The effects of acoustic and semantic similarities, between words, on short-term memory were studied.	N=40	Twenty-four. Five-word sequences were prepared being comprised of 12 sequences drawn at random.	Experimental	Findings indicated that both acoustic and semantic similarities had a significant effect on short-term memory recall of the words presented.
Cowan, N., Rouder, J. N., Blume, C. L., & Saults, J. S. (2012). Models of verbal working memory	Explores what aspects of working memory functioning is limited by working memory capacity and what aspects	Fifty-three undergraduate students from an introductory psychology course were examined.	Only a computer program which generated random words was used.	Experimental	Participants retained approximately three “chunks” indicating a typical limit for working memory. This article also discusses the affects of working memory capacity on long-term learning.

capacity: What does it take to make them work? <i>Psychological Review</i> , 119(3), 480-499. <a href="http://dx.doi.org/10.1037/a0027791">http://dx.doi.org/10.1037/a0027791</a>	are limited by other memory mechanisms				
Delacour, J. (1994). The memory system of the brain. In J. Delacour (Ed.), <i>Advance Series in Neuroscience: Vol. 4</i> , (pp. 24-30). <a href="http://dx.doi.org/10.1142/1702">http://dx.doi.org/10.1142/1702</a>	Discusses the memory system of the brain.	N/A	N/A	Theoretical	Discusses, in great detail, the various aspects of memory. Provides some rudimentary insight into functional neuroanatomy as it relates to aspects of memory.
Atkinson, R. C., & Shiffrin, R. M. (1968). Human memory: A proposed system and its control process. In K. M. Spence and J. T. Spence (Eds.), <i>The psychology of learning</i>	Developed the modal model of memory.	N/A	N/A	Theoretical	Developed one of the most important models of human memory, the Modal Model which describes acquisition of information from working memory to short-term memory and, in turn, to long-term memory.

<p>and motivation: <i>Advances in research and theory: Vol. 2</i>(pp. 52-63).  <a href="http://dx.doi.org/10.1016/s0079-7421(08)60422-3">http://dx.doi.org/10.1016/s0079-7421(08)60422-3</a></p>					
<p>Heuer, E., &amp; Bachevalier, J. (2011). Effects of selective neonatal hippocampal lesions on test of object and spatial recognition memory in monkeys. <i>Behavioral Neuroscience</i>, 125, 137-149.  <a href="http://dx.doi.org/10.1037/a0022539">http://dx.doi.org/10.1037/a0022539</a></p>	<p>Effects of hippocampal lesions, obtained in adulthood and infancy, on memory functioning.</p>	<p>Eighteen adult rhesus monkeys 3-5 years of age.</p>	<p>White noise generator. Surgical materials for sham-operations and lesion operations.</p>	<p>Experimental</p>	<p>No differences were found between groups for age or control versus treatment. Differences between groups on both levels were not significant.</p>
<p>Kumaran, D., &amp; McClelland, J. (2012). Generalization through the recurrent interaction of episodic memories:</p>	<p>The role of the hippocampus in generalization of memory.</p>	<p>N/A</p>	<p>N/A</p>	<p>Theoretical</p>	<p>Complex interactions between hippocampal regions and regions of the neocortex cause memory to generalize. Describes neuronal circuitry of memory.</p>

A model of hippocampal system. <i>Psychological Review</i> , 119, 573-616. <a href="http://dx.doi.org/10.1037/a0028681">http://dx.doi.org/10.1037/a0028681</a>					
Lezak, M. D., Howieson, D. B., Bigler, E. D., & Tranel, D. (2012). <i>Neuropsychological Assessment</i> (5th ed.). NY: Oxford University Press.	A book discussing the rudimentary aspects of functional neuroanatomy.	N/A	N/A	Theoretical/Book	This book discusses aspects of lateralization including left-lateral, right-lateral and frontal tasks. Lesions in these lobes are also discussed with explanations of functional deficits observed post-insult.
Luck, S. J., & Vogel, E. K. (1997). The capacity of visual working memory for features and conjunctions. <i>Nature</i> , 390, 279-281. <a href="http://dx.doi.org/10.1038/36846">http://dx.doi.org/10.1038/36846</a>	This article attempts to describe the capacity of visual working memory.	Ten neurologically normal college students.	Simple video monitor and image stimuli.	Experimental	The authors demonstrated that visual working memory has a larger capacity than previously described. Visual working memory does not only have the capacity to retain simple forms of information (e.g., the color of an object) but can also retain information regarding other aspects of objects such as orientation, position on a plane etc.

Markowitsh, H. J. (1994). Effects of emotion and arousal on memory processing by the brain. <i>Memory, Learning and the Brain</i> , 7, 210-240. <a href="http://dx.doi.org/10.1142/9789814354752_0005">http://dx.doi.org/10.1142/9789814354752_0005</a>	A book describing the memory system of the brain.	N/A	N/A	Theoretical/Book	The book goes into great detail describing the functional anatomy of the various lobes of the brain. Subcortical regions such as the hypothalamus, thalamus and reticular formations are also discussed. The author describes in detail deficits which may occur due to insult to specifically described regions of the human brain.
Reynolds, C. R., & Bigler, E. D. (1995). Factor structure, factor indexes, and other useful statistics for interpretation of the Test of Memory and Learning (TOMAL). <i>Archives of Clinical Neuropsychology</i> , 11, 29-43. <a href="http://dx.doi.org/10.10">http://dx.doi.org/10.10</a>	Analyses the validity and reliability of the TOMAL instrument.	N/A	N/A	Theoretical	A factor analysis was done for all TOMAL subtests based on responses of the original standardization sample. The major finding [contribution] was that the authors made available new normative tables and reliability data to be used for clinical work.

93/arclin/1 1.1.29					
Rouder, T. J., Cowan, N., Zwilling, C. E., Morey, C. C., & Pratte, M. S. (2008). An assessment fixed-capacity models of visual working memory. <i>Proceedings of the National Academy of Sciences</i> , 105, 5975-5979. <a href="http://dx.doi.org/10.1073/pnas.0711295105">http://dx.doi.org/10.1073/pnas.0711295105</a>	Tested the capacity of the visual working memory to assess for fixed capacity.	Twenty-three students from an introductory psychology class at the University of Missouri and Columbia were used.	Study arrays: Squares whose colors were sampled without replacement from 10 colors.	Experimental	Authors provided strong scientific support for the Fixed-capacity Model of the visual working memory system of the human brain. Authors conclude that fixed-capacity models hold as a scientific model of visual working memory.
Sander, A. M., Nakase-Richardson, R., Constantini, F., Wertheimer, J., & Paul, D. R. (2007). Memory assessment on an interdisciplinary team: A theoretically based framework.	Memory assessment on an interdisciplinary team: A theoretically based framework.	N/A	N/A	Theoretical	The authors provide a theoretical retrospective on models of memory. Authors discuss early models of memory as developed by Atkinson and Shiffrin (1968) and discuss how older models slowly became antiquated.



nary rehabilitati on team: A theoreticall y based framework. <i>American Journal of Speech- Language Pathology</i> , 16, 316- 330. <a href="http://dx.doi.org/10.1044/1058-0360(2007/036)">http://dx.do i.org/10.10 44/1058- 0360(2007/ 036)</a>					
Schneider, W., & Detweiler, M. (1987). A connectioni st/control architecture for working memory. In G. Bower (Ed.), <i>The psychology of learning and motivation: Advances in research and theory</i> (54-119). NY: Academic Press. <a href="http://dx.doi.org/10.1016/s0079-7421(08)60026-2">http://dx.do i.org/10.10 16/s0079- 7421(08)60 026-2</a>	A book discussing neuroanato my and motivation.	N/A	N/A	Theoretical/ Book	Memory as a domain is dependent on many other domains such as attention. Further, motivation and emotional responses also facilitate memory encoding.

Shelton, J. R., Martin, R. C., & Yaffee, L. S. (1990). Investigating a verbal short-term memory deficit and its consequences for language processing. <i>Cognitive Neuropsychology in Clinical Practice</i> , 6, 131-167. Retrieved from <a href="http://www.books.google.com">www.books.google.com</a>	Discusses verbal short-term memory deficits.	N/A	N/A	Theoretical	Covers aspects of short-term memory. A history of short-term memory models are provided and concurrent complex models are also presented.
Squire, L. R., & Zola-Morgan, S. (1991). The medial temporal lobe memory system. <i>Science</i> , 253, 1380-1386. <a href="http://dx.doi.org/10.1126/science.1896849">http://dx.doi.org/10.1126/science.1896849</a>	Corroborates that the anatomical components of the brain's memory system is primarily within the medial temporal lobes (bilaterally).	N/A	N/A	Theoretical	Emphasizes the importance of the connections between the medial temporal lobes, the cortex and other subcortical regions (e.g., entorhinal, perirhinal, and parahippocampal regions) in memory functioning.
Wheeler, M. W., & Treisman, A. M.	Article discussing the integration	N/A	N/A	Theoretical	Features from similar dimensions (of objects) may be competing for

(2002). Binding in short-term visual memory. <i>Journal of Experimental Psychology : General</i> , 131, 48-64. <a href="http://dx.doi.org/10.1037/0096-3445.131.1.48">http://dx.doi.org/10.1037/0096-3445.131.1.48</a>	of complex information in human working memory and its effects on shaping conscious cognition.				capacity of working memory in humans.
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## Visual Memory

Author/ Year	Research Questions/ Objectives	Sample	Variables/ Instruments	Research Approach/Design	Major Findings
Hollingworth, A. & Luck, S. J. (2008). Visual memory systems. In S. J. Luck & A. Hollingworth (Eds.), <i>Visual Memory</i> (pp. 3-8). New York, NY: Oxford University Press. <a href="http://dx.doi.org/10.1017/9780511525400.003">http://dx.doi.org/10.1017/9780511525400.003</a>	Describing the visual memory system in the brain.	N/A	N/A	Theoretical	Described, in detail, the neurocircuitry of the visual memory system. Described how information is obtained, registered and stored.

doi.org/10.1093/acprof:oso/9780195305487.03.0001					
Maj, M., Janssen, R., Satz, P., Zaudig, M., Starace, F., Boor, D., . . . Sartorius, N. (1991). The World Health Organization's cross-cultural study on neuropsychiatric aspects of infection with the human immunodeficiency virus (HIV-1). <i>British Journal of Psychiatry</i> , 159, 351-356. <a href="http://dx.doi.org/10.1192/bjpp.159.3.3">http://dx.doi.org/10.1192/bjpp.159.3.3</a>	A study conducted by the World Health Organization (WHO) to better understand the nature and of HIV-1 associated neurocognitive, psychiatric, and neuropsychological abnormalities. This was a geographically diverse study.	N=175 (127 men and 48 women) Participants were recruited from Brazil, Samples were taken from: Kenya Germany, Thailand, United States, and Zaire. It included 62 HIV-1 asymptomatic individuals, 53 HIV-1 symptomatic individuals, and 60 healthy adults.	Domains assessed: reaction time, attention, selective attention, perceptual/motor analysis, cognitive flexibility, verbal and visual memory. Instruments used included the (WHO/UC LA Picture Memory Interference Test), and verbal fluency.	Causal-Comparative	Study aimed to provide a comprehensive evaluation of instruments, especially for the assessment of HIV-1-associated neurocognitive disorders caused by the HIV-1 virus. Due to the wide spread nature of the HIV-1 virus, many multi-culturally fair instruments, such as the PMIT were developed and used for this study. Data was collected on the types of cognitive deficits observed in those in advanced stages of the disease.

51					
Benedict, R., Schretlen, D., Groninger, L., Dobraski, M., & Shpritz, B. (1996). Revision of the Brief Visuospatial Memory Test: Studies of normal performance, validity and reliability. <i>Psychological Assessment</i> , 8, 145-153. <a href="http://dx.doi.org/10.1037/1040-3590.8.2.145">http://dx.doi.org/10.1037/1040-3590.8.2.145</a>	Development of the Brief visual Memory Test. Validation/reliability assessment.	N/A	BVMT	Theoretical	Describes the development, administration, normalization, validation and assessment of reliability for the BVMT.
Manly, J. J., & Echemendia, R. J. (2007). Race-specific norms: Using the	Reports issues regarding race culture and education using specific normalization	N/A	N/A	Theoretical	Offers an overview of universalism, which assumes that cognitive processes are stable across cultures, as a limitation in neuropsychology.

model of hypertension to understand issues of race, culture, and education in neuropsychology. <i>Archives of Clinical Neuropsychology</i> , 22, 319-325. <a href="http://dx.doi.org/10.1016/j.acn.2007.01.006">http://dx.doi.org/10.1016/j.acn.2007.01.006</a>	n data.				
Osterrieth, P. A. (1944). Le test de copie d'une figure complexe [The copy test of the complex figure]. <i>Archives of Psychology</i> , 30, 206-356. Retrieved from <a href="http://www.scholar.google">www.scholar.google</a>	Effects of age on performance on the Rey-O.	N/A	Rey-Osterrieth Complex Figure Test.	Experimental	A test prepared by Rey was used in an attempt to study the development of the ability to copy and recall a complex figure. Suggests that age greatly affects performance on the Rey-O with older adults performing worse. Discusses effects of aging on visual memory.

le.com					
Rey, A. (1941) L'examen psychologique dans les cas d'endéphalopathie traumatique [The psychological examination in cases of traumatic encephalopathy]. <i>Achieves of Psychology</i> , 28, 286-340. Retrieved from <a href="http://psycnet.apa.org/psycinfo/1943-03814-001">http://psycnet.apa.org/psycinfo/1943-03814-001</a>	Describes aspects of visual memory in those suffering from TBI.	N/A	Rey-Osterieth Complex Figure Test.	Theoretical	Found method of differentiating between types of TBI via deficits exhibited by the subject/patient.
Wechsler, D. (1997b). Wechsler Memory Scale-Third Edition. San Antonio, TX: The Psycholo	N/A	N/A	WMS-III	N/A	WMS-III manual

gical Corporati on.					
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### The PMIT: Background and History

Author/ Year	Research Questions/ Objectives	Sample	Variables/ Instrumen ts	Research Approach/D esign	Major Findings
Franco, G. (2009). <i>Utilizing the Picture Memory Interfere nce Test (PMIT) for the detection of simulated memory impairme nt in a monoling ual male Spanish- speaking Latino sample</i> (Doctoral dissertati on). Retrieved from ProQuest. (1850698 031).	Doctoral dissertation looking to use the PMIT for the detection of memory impairment in a monolingual , male Spanish- speaking population.	Sixty male, Spanish- speaking, monolingual participants . Ages ranged from 18 to 49.	The picture Memory Interfere nce Test was used.	Experimental	Findings indicated that there was a statistically significant difference found in scores between those who took the test under normal circumstances and those who were malingering. Sensitivity and specificity rates were also calculated and provided for future use.
Snodgras s, J. G., & Vanderw art, M. (1980). A	The article discusses the standardizat ion process of a set of	N=219 All participants were volunteers. All were	Black and white images.	Experimental /Standardizat ion	Images were standardized amongst 219 participants. Participants were asked to judge the images in several ways including,



standard set of 250 pictures: Norms for naming, agreement, familiarity and visual complexity. <i>Journal of Experimental Psychology: Human Learning and Memory</i> , 6, 174-216. <a href="http://dx.doi.org/10.1037/0016-9146.6.2.174">http://dx.doi.org/10.1037/0016-9146.6.2.174</a>	260 images for use in future experiment.	native English-speakers.			determining how closely the image of the object relates to the internal image of the object within the participants mind, how often the object is seen within their immediate environment and naming agreement (asking participant to name the object in one word).
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## The CMIT and what it Measures-No citations

### Validity

Author/ Year	Research Questions/ Objectives	Sample	Variables/ Instruments	Research Approach/Design	Major Findings
Barker, C., Pistrange, N., & Elliot, R. (2002). <i>Research</i>	Methods in clinical psychology: An introduction for students and	N/A	N/A	Theoretical	Overview of quantitative research methods for those unfamiliar with advanced methodology.

<p><i>methods in clinical psychology: An introduction for students and practitioners.</i> West Sussex, England: John Wiley &amp; Sons, Ltd.  <a href="http://dx.doi.org/10.1002/0470013435">http://dx.doi.org/10.1002/0470013435</a></p>	practitioner.				
<p>Burgess, P. W., Alderman, N., Evans, J., Emslie, H., &amp; Wilson, B.A. (1998). The ecological validity of tests of executive functioning. <i>Journal of the International Neuropsychological Society</i>,</p>	<p>Studied the efficacy of neuropsychological instruments testing frontal lobe functioning.</p>	<p>N=92 Neurology patients were compared to 216 control individuals.</p>	<p>FAS (animals), Trail Making Test, Simplified Six Element Test, Wisconsin Card Sorting Test, Cognitive Estimates Test and the FAS.</p>	<p>Experimental</p>	<p>Showed that the tested Instruments of executive functioning do well when predicting ecological behaviors. Scores on the instruments were consistent with those behaviors reported by caregivers.</p>

4, 547-558. <a href="http://dx.doi.org/10.1017/s1355617798466037">http://dx.doi.org/10.1017/s1355617798466037</a>					
DeVon, H., Block, M., Moyle-Wright, P., Erns, D., Hayden, S., Lazzara, D., . . . Kostas-Polston, E. (2007). A psychometric toolbox for testing validity and reliability . <i>Journal of Nursing Scholarship</i> , 39(2), 155-164. <a href="http://dx.doi.org/10.1111/j.1547-5069.2007.00161.x">http://dx.doi.org/10.1111/j.1547-5069.2007.00161.x</a>	Reviews the concepts of reliability and validity.	N/A	N/A	Theoretical	This article discusses the various types of validity and reliability, how the concepts have been used in the field of nursing and how these concepts can be used to improve psychometrics. This article was a meta-analysis of several articles published on this topic with in the past five years. Findings indicated that content validity was frequently indicated however criterion validity was rarely reported.

Gioia, D. (2009). Understanding the ecological validity of neuropsychological testing using an ethnographic approach. <i>Qualitative Health Research</i> , 19(10), 1495-1503. <a href="http://dx.doi.org/10.1177/1049732309348500">http://dx.doi.org/10.1177/1049732309348500</a>	Attempts to establish ecological validity of instruments based on laboratory tests.	N=10 All participants were suffering from schizophrenia.	N/A	Experimental	The authors developed an observational method to assess the behavioral aspects of patients suffering from schizophrenia. The data collected from this prolonged period of observation can then be compared to laboratory findings. Agreement between laboratory findings and observational assessment indicates ecological validity of the observational assessment method.
Lissitz, R.W. (Ed.). (2009). <i>The concept of validity: Revisions, new directions, and applications</i> . Charlotte, NC: Information Age Publishing.	A book discussing the many aspects of validity.	N/A	N/A	Theoretical	Describes the importance of establishing validity of instruments prior to applying neuropsychological instruments clinically or scientifically. An instrument which has not had its validity established is of no use. The importance of reliability is also discussed.

<a href="http://dx.doi.org/10.1007/s11336-010-9180-6">http://dx.doi.org/10.1007/s11336-010-9180-6</a>					
Messick, S. (1980). Test validity and the ethics of assessment. <i>American Psychologist</i> , 35(11), 10-12. <a href="http://dx.doi.org/10.1037//0003-066x.35.11.1012">http://dx.doi.org/10.1037//0003-066x.35.11.1012</a>	This article discusses (1) the importance of test validity and (2) the importance of vetting the value of test implications.	N/A	N/A	Theoretical	Provides an in-depth descriptions of the various aspects of validity including, content validity, criterion validity, construct validity, task validity. The interpretive meaning of all these different types of validity are also discussed in great detail.
Sireci, S. (1998). The construct of content validity. <i>Social Indicator Research</i> , 45, 83-117. <a href="http://dx.doi.org/10.1023/a:1006985528729">http://dx.doi.org/10.1023/a:1006985528729</a>	Is validity an inherent characteristic of instruments.	N/A	N/A	Theoretical	Validity must be established and is not an inherent aspect of Instruments. Also discussed in great detail, the developed instrument. This may seem a bit obvious to point out at this point, however, given the many differing kinds of validity which have been developed, it is important to remember this fact for all aspects of validity.

## Reliability

Author/ Year	Research Questions/ Objectives	Sample	Variables/ Instrumen ts	Research Approach/D esign	Major Findings
Barker, C., Pistrange, N., & Elliot, R. (2002). <i>Research methods in clinical psychology: An introduction for students and practitioners</i> . West Sussex, England: John Wiley & Sons, Ltd. <a href="http://dx.doi.org/10.1002/0470013435">http://dx.doi.org/10.1002/0470013435</a>	Research methods in clinical psychology: An introduction for students and practitioner.	N/A	N/A	Theoretical	Overview of quantitative research methods for those unfamiliar with advanced methods.
Cook, D., & Beckman, T. (2006). Current concepts in validity and reliability for	In this article enquires about the important aspects of validity. Namely, is it wise to replace the concepts of face, construct,	N/A	N/A	Theoretical	Evidence to support their argument is gathered from five sources including, content, response process, internal structure, relations to other variables and consequences (do scores really make a difference).

psychometric instruments: Theory and application. <i>The American Journal of Medicine</i> , 119, 166e7-166e16. <a href="http://dx.doi.org/10.1016/j.amjmed.2005.10.036">http://dx.doi.org/10.1016/j.amjmed.2005.10.036</a>	and criterion validity with the concept of construct validity.				Conclusions indicate that reliability is a necessity for establishing validity, but not sufficient.
DeVellis, R. F. (2012). <i>Scale development: Theory and application</i> (3rd ed.). Los Angeles, CA: Sage. <a href="http://dx.doi.org/10.1177/109821409301400212">http://dx.doi.org/10.1177/109821409301400212</a>	Discusses the methods of establishing reliability when test-retest methods are not possible.	N/A	N/A	Theoretical	Many methods of establishing reliability are discussed. These Cronbach's <i>alpha</i> , the split-half method, and the Spearman-Brown method. It is recommended that whenever test-retest methods are not possible to use alternative methods such as the split-half method.

## Reliability and Validity of Current Measures

Author/ Year	Research Questions/ Objectives	Sample	Variables/ Instrumen ts	Research Approach/D esign	Major Findings
Ardila, A., Rosselli, M., & Puente, A. E. (1994). <i>Neuropsychological evaluation of the Spanish speaker</i> . New York, NY: Plenum Press. <a href="http://dx.doi.org/10.1016/s0887-6177(96)90023-2">http://dx. doi.org/1 0.1016/s0 887- 6177(96) 90023-2</a>	Assessing reliability and validity of WMS.	N/A	Multiple measures discussed.	Theoretical	Neuropsychological evaluation with Spanish-speakers. Evaluating the reliability and validity of WMS. Findings indicated Spanish version is comparable to English version.
Bennett- Levy, J. (1984). Determin ants of performa nce on the Rey- Osterriet h Complex Figure Test: An analysis, and a new	What are the factors involved in producing effective scores for the Rey-O.	N=107 All healthy adults.	Rey-O shore and long delay.	Experimental	A regression equation was developed fore predicting performance. Inter- rater reliability was also assessed.



<p>technique for single-case assessment.</p> <p><i>British Journal of Clinical Psychology</i>, 23, 109-110.</p> <p><a href="http://dx.doi.org/10.1111/j.2044-8260.1984.tb00634.x">http://dx.doi.org/10.1111/j.2044-8260.1984.tb00634.x</a></p>					
<p>Deckersb ack, T., Otto, M. W., Savage, C. R., Baer, L., &amp; Jenike, M. A. (2000). The relationsh ip between semantic organizat ion and memory in obsessive compulsi ve disorder. <i>Psychoth erapy and</i></p>	<p>A laterali zation study with OCD patients.</p>	<p>N=17 All untreated OCD out- patients.</p>	<p>Rey-O</p>	<p>Experimental</p>	<p>Non-dominant hemispheric functioning is less effected in OCD patients.</p>

<i>Psychosomatics</i> , 69(2), 101-107. <a href="http://dx.doi.org/10.1159/00012373">http://dx.doi.org/10.1159/00012373</a>					
Kaufman, A. S. (2001). WAIS-III IQs, Horn's theory, and generational changes from young adulthood to old age. <i>Intelligence</i> , 29, 131-167. <a href="http://dx.doi.org/10.1016/S0160-2896(00)00046-5">http://dx.doi.org/10.1016/S0160-2896(00)00046-5</a>	What is the relationship between age and IQ.	WAIS-III normalization data $N=2,450$ and 17 individuals for longitudinal study.	WAIS-R/WAIS-III	Experimental/longitudinal	Describes "generational" changes in light of "Horn's theory" as it pertains to the WAIS-III/WAIS-R.
Knight, J. A., Kaplan, E., & Ireland, L. (2003). Survey findings of Rey-Osterrieth	Data regarding the usages of the Rey-O instrument.	N/A	N/A	Survey	It was found that the Rey-O has become increasingly popular since 2003. A number of different administration procedures have been developed.

Complex Figure usage. In J. A. Knight (Ed.), <i>The handbook of Rey-Osterrieth complex figure usage: Clinical and research applications</i> (pp. 45-75). Lutz, FL: Psychological Assessment Resources.					
Liberman, N., Stewart, W., Selnes, O., & Gordon, B. (1994). Rater agreement for the Rey-Osterrieth Complex Figure Test. <i>Journal</i>	What is the efficacy of the inter-rater reliability of the Rey-O.	N=486 Male, amateur boxers.	All aspects of the Rey-O.	Experimental	Reported extremely high inter-rater reliability for all aspects of the Rey-O.

<p>of Clinical Psychology, 50(4), 615-624. <a href="http://dx.doi.org/10.1002/1097-4679(199407)50:4&lt;615::aid-jclp2270500419&gt;3.0.co;2-r">http://dx.doi.org/10.1002/1097-4679(199407)50:4&lt;615::aid-jclp2270500419&gt;3.0.co;2-r</a></p>					
<p>Maj, M., D'Elia, L., Satz, P., Jansses, R., Zaudig, M., Uchiyama, C., . . . Chervinsky (1993). Evaluation of two new neuropsychological tests designed to minimize cultural bias in the assessment of HIV-1 seropositive</p>	<p>What is the multicultural utility of the AVLT within research and clinical settings?</p>	<p>N=60 Healthy adults from multiple countries used and 12 HIV-1 positive participants with 12 HIV-1 negative control.</p>	<p>AVLT and the Colors Trails A and B.</p>	<p>Experimental</p>	<p>It was determined that the multicultural utility of both instruments assessed holds.</p>

persons: A WHO study. <i>Archives of Clinical Neuropsychology</i> , 8, 123- 135. <a href="http://dx.doi.org/10.1093/arclin/8.2.123">http://dx. doi.org/1 0.1093/ar clin/8.2.1 23</a>					
Messinis, L., Taskona, I., Kollara, P., Malefaki, S., & Papathan asopoulo s, P. (2007). Neuropsychological deficits of HIV seropositive patients in different stages of the disease process. <i>Psychology: Journal of the Hellenic Psychology</i>	Assesses neuropsychological deficits in HIV positive Individuals.	N/A	N/A	Theoretical	Sensitivity of NP instruments to assess deficits in HIV positive individuals.

<i>gical Society, 6(2), 435-446.</i>					
Mitrushina, M., Boone, K., Razani J., & D'Elia, L. (2005). <i>Handbook of normative data for neuropsychological assessment</i> . New York, NY: Oxford University Press.	Provides normalization for a variety of instruments.	N/A	N/A	Theoretical	Provided information regarding the reliability of the Rey-O instrument.
Neblina, C. (2012). <i>Construct and criterion validity of the Rey Auditory Verbal Learning Test-Spanish version in adults with traumatic brain injury</i>	Reliability and validity of RAVLT-S.	N=106 Adults	RAVLT-S	Experimental	Assess the reliability and validity of the RAVLT-S. Findings indicated that this instrument is comparable to the English version.

(Doctoral dissertation). Retrieved from Google Scholar.					
Rey, A. (1964). <i>L'examen clinique an psychologie</i> [Clinical tests in psychology]. Paris, France: Presses Universitaires de France. Retrieved from <a href="http://www.scholar.google.com">www.scholar.google.com</a>	Development of the RAVLT.	N/A	Multiple Instruments	Theoretical	The development of the RAVLT is described.
Renteria, L., Li, S. T., & Pliskin, N. H. (2008). Reliability and validity of the Spanish language Wechsler Adult Intelligence Scale in a	Is the WAIS-III Spanish version valid and reliable.	N/A	WAIS-III	Experimental	Assess the reliability and validity of the WAIS-III. Spanish version was found to be comparable to the English version.

sample of American, urban, Spanish-speaking Hispanics. <i>Clinical Neuropsychology</i> , 22, 455-470. <a href="http://dx.doi.org/10.1080/13854040701336428">http://dx.doi.org/10.1080/13854040701336428</a>					
Snodgrass, J. G., & Vanderwart, M. (1980). A standard set of 250 pictures: Norms for naming, agreement, familiarity and visual complexity. <i>Journal of Experimental Psychology: Human Learning and Memory</i> ,	The article discusses the standardization process of a set of 260 images for use in future experiments.	N=219 All were native English speakers.	Black and white images.	Experimental	Images were standardized amongst 219 participants. Participants were asked to judge the images in several ways including, determining how closely the image of the object relates to the internal image of the object within the participants mind, how often the object is seen within their immediate environment and naming agreement (asking participant to name the object in one word).



6, 174-216. <a href="http://dx.doi.org/10.1037/0278-7393.6.2.174">http://dx.doi.org/10.1037/0278-7393.6.2.174</a>					
Tupler, L. A., Welsh, L. A., Asare-Aboagye, Y., & Dawson, D. V. (1995). Reliability of the Rey-Osterrieth Complex Figure in use with memory-impaired patients. <i>Journal of Clinical and Experimental Neuropsychology</i> , 17(4), 566-579. <a href="http://dx.doi.org/10.1080/01688639508405146">http://dx.doi.org/10.1080/01688639508405146</a>	What is the reliability of the Rey-O when used with memory-impaired individuals?	N=95, elderly participants with memory impairment.	Rey-O Copy and Recall Trials	Experimental	Reported high inter-rater reliability for the copy as well as the recall trial.
Wechsler	N/A	N/A	WAIS-III	N/A	WAIS-III manual

, D. (1997a). Wechsler Adult Intelligen ce Scale- Third Edition. San Antonio, TX: The Psycholo gical Corporati on.					
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### The Need for Culturally Appropriate Instruments

Author/ Year	Research Questions/ Objectives	Sample	Variables/ Instrumen ts	Research Approach/D esign	Major Findings
American Psycholo gical Associati on. (2002). Ethical principles of psycholo gists and code of conduct. <i>American Psycholo gist</i> , 57, 1060- 1073. <a href="http://dx.doi.org/10.1037/0003-066x.57.12.1060">http://dx. doi.org/1 0.1037//0 003- 066x.57. 12.1060</a>	Guidelines for psychologist s put forth by the American Psychologic al Association regarding culturally fair practice.	N/A	N/A	Theoretical	The provided guidelines were developed to provide psychologists with a rationale for addressing multicultural issues in practice, training, research, and organizational entities. These guidelines are empirically supported. Finally, these guidelines encourage psychologists of all kinds to continue developing their own multicultural skills.
Artiola,	Discusses	N/A	N/A	Theoretical	Potential pitfalls of

P., Fortuny, L., & Mullaney, H. (1998). Assessing patients whose language you don't know: Can the absurd be ethical? <i>The Clinical Neuropsychologist</i> , 12, 113-126. <a href="http://dx.doi.org/10.1076/cln.12.1.113.1727">http://dx.doi.org/10.1076/cln.12.1.113.1727</a>	the problems that may arise when English-speaking examinees examine non-English-speaking examinees.				evaluating patients who are not English-speakers are presented. Suggestions are provided to those examiners who may be forced to examine non-English-speaking patients. Further a review of the ethics code is provided to help clinicians to avoid unethical or illegal practices.
Brickman, A. M., Cabo, R., & Manly, J. J. (2006). Ethical issues in cross-cultural neuropsychology. <i>Applied Neuropsychology</i> , 13, 91-100. <a href="http://dx.doi.org/10.1207/s1">http://dx.doi.org/10.1207/s1</a>	This article describes the challenges neuropsychologist can face when assessing patients from diverse cultural and linguistic backgrounds.	N/A	N/A	Theoretical	The challenges of assessing patients from diverse backgrounds are discussed. Four key issues are discussed: (1) The importance of considering culture or race in neuropsychological testing, (2) use of race- and ethnicity-specific normative data in neuropsychological assessment, (3) competency in proper administration of instruments for ethnic minority groups as well as non-English-

5324826an1302_4					speakers, (4) competency interpretation of tests designed for ethnic minority groups, (5) proper training models which provide students with multicultural assessment skills.
Mindt, M. R., Byrd, D., Saez, P., & Manly, J. (2010). Increasing culturally competent neuropsychological services for ethnic minority populations: A call to action. <i>The Clinical Neuropsychologist</i> , 24, 429-453. <a href="http://dx.doi.org/10.1080/13854040903058960">http://dx.doi.org/10.1080/13854040903058960</a>	This article highlights the increasing need for culturally appropriate neuropsychological services.	N/A	N/A	Theoretical	This article continues the nature versus nurture discussion, stating that neuropsychologists have adopted the “nurture” aspect of the argument (Universalism) and have therefore freed themselves of having to consider cultural factors. The authors believe cognitive domains should be examined in light of cultural factors. It is reported that performance on neuropsychological instruments will differ due to cultural difference between examinees. Finally, recommendations are provided.
Nell, V. (2000). <i>Cross-cultural neuropsychological</i>	A book discussing cross-cultural neuropsychological	N/A	N/A	Theoretical	This book was written for neuropsychologists who often assess individuals of different cultures. It provides neuropsychologists

<i>l assessment: Theory and practice.</i> Mahwah, NJ: Lawrence Erlbaum Associate s. Retrieved from www.boo ks.google .com	assessment.				<p>with an understanding of how improper use of normalization data can affect neuropsychological results. The author also discuss the importance of proper development of instrument including establishing validity and reliability. The author expresses concern regarding the increases in migration into the United States in the face of lack of appropriate services available for migrant individuals. The author presents the idea of radical environmentalism which is described, as the interaction between biological, socioeconomic, and cultural determinants in the development of personality.</p>
Perez-Arce, P. (1999). The influence of culture on cognition . <i>Archives of Clinical Neuropsychology</i> , 14, 581-592. <a href="http://dx.">http://dx.</a>	Author proposes that cultural factors have a determining influence on an individual's behavior, regardless of their neuron-physiologic al status of the brain. A differentiat	N/A	N/A	Theoretical	Provides a theoretical structure to help understand the relationship between cognition and behavior within the context of the individual's ecological brain (that is, biological factors, idiopathic psychological development and sociocultural environment. First, neuropsychology has neglected sociocultural development.

doi.org/10.1093/arclin/14.7.581	on is made between the effects of culture/language and socioeconomic level on cognitive testing results for Latino patients.				Therefore, the author presents a “socially shared cognition” perspective to understand the role of cultural variables in cognition. Second, a human’s experience of the world is shaped not only by neuropsychological factors but also the sociocultural factors to which the individual has been exposed.
United States Census Bureau. (2007). Minority population tops 100 million [Press release]. CB07-70. Retrieved from <a href="http://www.prnewswire.com">http://www.prnewswire.com</a>	Data regarding U.S. minority population rates.	N/A	N/A	Survey	The U.S. Census Bureau’s data for the country’s ethnic minority population. Population estimates are provided for African Americans, Hispanics, Asians, American Indians and Alaskan Natives and Native Hawaiians as well as other Pacific Islanders and Non-Hispanic Whites. Census data indicates drastic increases in minority populations.

### Characteristics of Population under Study

Author/Year	Research Questions/Objectives	Sample	Variables/Instruments	Research Approach/Design	Major Findings
Pew Hispanic Center. (2010). Statistical	A website which presents detailed demographic information	N/A	N/A	Quantitative	Reported that over one-half of Latino immigrants, at the time, had yet to master the English language and were more likely to be medically

portrait of Latinos in the United States, 2008. Retrieved May, 2011 from <a href="http://pewhispanic.org/files/factsheets/Hispanics2008/2008%20Hispanic%20Profile%20Final.pdf">http://pewhispanic.org/files/factsheets/Hispanics2008/2008%20Hispanic%20Profile%20Final.pdf</a>	regarding the Latino population.				uninsured when compared to other ethnic groups.
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## Research Methods

Author/ Year	Research Questions/ Objectives	Sample	Variables/ Instruments	Research Approach/Design	Major Findings
Maj, M., Janssen, R., Satz, P., Zaudig, M., Starace, F., Boor, D., . . . Sartorius,	A study conducted by the World Health Organization to better understand the nature of the effects	N=175, 127 men and 48 women were recruited from Brazil, Kenya, Germany	Multiple instruments were used including the CMIT.	Causal-comparative	The study aimed to provide a comprehensive evaluation of instruments, especially for the assessment of HIV-1-associated neurocognitive disorders caused by the HIV-1 virus. Due to the

N. (1991). The World Health Organization's cross-cultural study on neuropsychiatric aspects of infection with the human immunodeficiency virus (HIV-1). <i>British Journal of Psychiatry</i> , 159, 351-356. <a href="http://dx.doi.org/10.1192/bjp.159.3.351">http://dx.doi.org/10.1192/bjp.159.3.351</a>	of the HIV-1 virus on cognition. This was a geographically diverse study.	and other countries.			wide spread nature of the HIV-1 virus, many multi-culturally fair instruments, such as the PMIT were developed and used for this study. Data collected on types of cognitive deficits present in those studied.
Kaufman, A. S., & Lichtenberger, E. O. (1999). Overview. In A. S. Kaufman, & N. L. Kaufman (Eds.), <i>Essentials of WAIS-III assessment</i>	Describes the protocols and procedures involved in the administration of the WAIS-III instrument.	N/A	N/A	Theoretical	Describes in detail, the protocols standardization data, and other pertinent information regarding the WAIS-III.



nt (1st ed., pp. 8-15). New York, NY: John Wiley & Sons. <a href="http://dx.doi.org/10.1177/0734282909357450">http://dx.doi.org/10.1177/0734282909357450</a>					
Kim, H. (2013). Statistical notes for clinical researchers: Assessing normal distribution using skewness and kurtosis. <i>Restorative Dentistry and Endodontics</i> , 5(4), 52-54. <a href="http://dx.doi.org/10.5395/rde.2013.38.1.52">http://dx.doi.org/10.5395/rde.2013.38.1.52</a>	Parameters for kurtosis and skewness.	N/A	N/A	Theoretical	Establishes parameters for assessing kurtosis and skewness.

## Results

Author/ Year	Research Questions/ Objectives	Sample	Variables/ Instrumen ts	Research Approach/D esign	Major Findings
Kline, P. (2000). <i>A psychome trics primer</i> . London, UK: Free Associati on Books.	Statistics in psychometri cs.	N/A	N/A	Chapter in a Book.	Discusses parameters for Cronbach's <i>alpha</i> .

## Discussion

Author/ Year	Research Questions/ Objectives	Sample	Variables/ Instrumen ts	Research Approach/D esign	Major Findings
Psycholo gical Corporati on. (1999). <i>Wechsler Abbreviat ed Scale of Intelligen ce</i> . San Antonio, TX: Author. <a href="http://dx.doi.org/10.1037/t15170-000">http://dx. doi.org/1 0.1037/t1 5170-000</a>	Develop ment of the WASI.	N/A	N/A	Theoretical	Manual for the WASI.
Meyer, M. (2000). <i>Use of the Wechsler Abbreviat</i>	Use of the WASI with rehabilitatio n population.	N=176	WASI	Experimental	Correlations between the WASI and the WAIS were Studied.

ed Scale of Intelligence in a vocational rehabilitation sample (Doctoral dissertation). Retrieved from <a href="https://etd.ohiolink.edu/">https://etd.ohiolink.edu/</a>					
Bishara, A., & Hittner, J. (2012). Testing the significance of a correlation with non-normal data: Comparison of Pearson, Spearman, transformation, and resampling approach. <i>Psychological Methods</i> , 17(3), 399-417.	Pearson v. Spearman with non-normally data.	N/A	N/A	Theoretical	Study investigated the usefulness of Spearman's versus Pearson correlations with non-normally distributed data. Transformation methods were also studied.

<a href="http://dx.doi.org/10.1037/a0028087">http://dx.doi.org/10.1037/a0028087</a>					
Bowler, D., Limoges, E., & Mottron, L. (2009). Different verbal learning strategies in autism spectrum disorder: Evidence from the Rey Auditory Verbal Learning Test. <i>Journal of Autism and Developmental Disorder</i> , 39(6), 910-915. <a href="http://dx.doi.org/10.1007/s10803-009-0697-4">http://dx.doi.org/10.1007/s10803-009-0697-4</a>	Assessing strategies for learning on the RAVLT with participants with autism.	N=21	RAVLT	Experimental	Participants who practiced over-rehearsal performed significantly better than those who did not.
Hessen, E. (2011). Rehearsal significantly improves	Assessing strategies for learning on the RAVLT.	N=50	RAVLT	Experimental	Participants who practiced over-rehearsal performed significantly better than those who did not.

<p>immediate and delayed recall on the Rey Auditory Verbal Learning Test.</p> <p><i>Applied Neuropsychology</i>, 18(4), 263-268.</p> <p><a href="http://dx.doi.org/10.1080/09084282.2011.595452">http://dx.doi.org/10.1080/09084282.2011.595452</a></p>					
<p>Park, D., Lautenschlager, G., Hedden, T., Davidson, N., Smith, A. (2002). Models of visuospatial and verbal memory across the adult life span.</p> <p><i>Psychology and Aging</i>, 17(2), 299-320.</p> <p><a href="http://dx.doi.org/10.1080/09084282.2011.595452">http://dx.doi.org/10.1080/09084282.2011.595452</a></p>	<p>Assessing the visuospatial memory versus verbal across the life-span.</p>	<p>N=345</p>	<p>Spatial Span, Digit Span, Line Span, Letter Rotation, RVDLT, BVRT, Vision Test, Audition Test.</p>	<p>Experimental</p>	<p>Visuospatial and verbal memory correlate even in decline.</p>

0.1037/0882-7974.17.2.299					
Giambra, L., Arenberg, D., Zonderman, A., Kawas, C., & Costa P. (1995). Adult life span changes in immediate visual memory and verbal intelligence. <i>Psychology and Aging</i> , 10(1), 123-139. <a href="http://dx.doi.org/10.1037/0882-7974.10.1.123">http://dx.doi.org/10.1037/0882-7974.10.1.123</a>	Assessing decline of visual memory and verbal memory as individuals age.	N=558 women N=1,163 men.	BVRT	Experimental	Visual memory and verbal memory correlate significantly even in decline in old age.
Friedman, N., Miyake, A., Corley, R., Young, S., DeFries, J., &	Executive functioning as it relates to overall intelligence.	N=234	WAIS, Stoop, Stop-Signal, Antisaccade, Color-shape, Raven, Category Switching.	Experimental	Executive functioning is highly correlated with intelligence and NP tests are not sensitive to this.

Hewitt, J. (2006). Not all executive functions are related to intelligence. <i>Psychological Science</i> , 17(2), 172-179. <a href="http://dx.doi.org/10.1111/j.1467-9280.2006.01681.x">http://dx.doi.org/10.1111/j.1467-9280.2006.01681.x</a>					
Bagby, R., Graeme, J., James, D., & Parker, A. (1994). The twenty-item Toronto Alexithymia Scale-II convergent, discriminant, and concurrent validity. <i>Journal of Psychosomatic Medicine</i> , 36(1), 10-15.	Establishing the reliability and validity of the TAS-20.	N=85	TAS-20, Psychological Mindedness Scale, NEO-PI.	Experimental	The convergent, discriminant and concurrent validity of the TAS-20 was established.

<i>matic Research</i> , 38(1), 33-40. <a href="http://dx.doi.org/10.1016/0022-3999(94)90006-x">http://dx.doi.org/10.1016/0022-3999(94)90006-x</a>					
Benedict, R., Amato, M., Boringa, J., Brochet, B., Foley, F., Fredrikson, S., . . . Langdon, D. (2012). Brief international cognitive assessment for MS (BICAMS: International standards for validation. <i>Biomedical Center Neurology</i> , 12(55), 1-8. <a href="http://dx.doi.org/10.1186/1">http://dx.doi.org/10.1186/1</a>	Assessing validity of the BICAMS international populations.	N/A	BICAMS, CVLT2, BVMTR	Theoretical	Facilitated the validation and acceptance of the BICAMS.



471-2377-12-55					
Silverberg, N., Hanks, R., & Tomkins, S. (2013). Education quality, reading recognition, and racial differences in the neuropsychological outcomes from traumatic brain injury. <i>Archives of Clinical Neuropsychology</i> , 28, 485-491. <a href="http://dx.doi.org/10.1093/arcclin/act023">http://dx.doi.org/10.1093/arcclin/act023</a>	Adjusting normative data for education with ethnic populations.	N=50	WTAR	Experimental	Ethnic populations require ethnic-specific normalization data for proper assessment.

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## APPENDIX B

### Tables

## APPENDIX B

### Tables

Table B1

*Sample Frequencies by Education*

Variable	Range	<i>M</i>	<i>SD</i>
Education	1-20	10.57	3.384
Variable	Frequency	Percent	Cumulative %
Education			
1-3	3	2.4	2.4
4-6	16	12.6	15
7-9	33	25.9	40.9
10-12	45	35.4	76.3
13-15	18	14.1	90.4
16-20	12	9.6	100

*Note:* Sample was broken down by education. The percentages for missing data were calculated separately as a portion of the overall sample of 131 individuals

Table B2

*Sample Frequencies by Age*

Variable	Range	<i>M</i>	<i>SD</i>
Age (total)	21-62	44.35	8.79
Variable	Frequency	Percent	Cumulative %
Age (21-41)	44	34.8	34.8
Age (42-62)	83	65.2	100.0

*Note:* The sample broken down by age. Percentages for missing data were calculated separately as a portion of the overall sample.

Table B3

*Sample Frequency by Gender*

Variable	Frequency	Percent	Cumulative %
Gender			
Male	99	78	78
Female	16	12	90
Missing	12	10	100

*Note:* The sample broken down by Gender. Percentages for missing data were calculated separately as a portion of the overall sample.

Table B4

*Analysis of Distribution*

Variable	Skewness	Kurtosis	<i>N</i>
Book/Score			
1	-2.264*	9.741*	78
2	-.560	-.234	78
3	-.865	.778	78
4	-1.079	1.565	77
5	-6.054*	44.170*	77
Total	-.487	-.323	77

*Note:* Skewness and Kurtosis values for the 5 CMIT books as well as the CMIT Total Score. Books 1 and 5 show anomalous distributions.

Table B5

*Correlations between PMIT scores and related constructs*

	PMIT 1 <sup>a</sup> (n=78)	PMIT 2 <sup>b</sup> (n=78)	PMIT 3 <sup>b</sup> (n=78)	PMIT 4 <sup>b</sup> (n=77)	PMIT5 <sup>a</sup> (n=77)	PMIT Total <sup>t</sup> (n=77)
WAIS Block Design	.015	.33**	.37**	.318**	.219	.366**
WAIS Matrix Reasoning	.03	.22*	.25*	.251*	.153	.267*
WAIS Vocabulary	.02	.33**	.38**	.385**	.275	.438***
RAVLT trial 1	.01	-.04	-.02	.076	.085	.033
RAVLT trial 2	-.18	.16	.09	.145	.208	.191 <sup>†</sup>
RAVLT trial 3	-.14	.21 <sup>†</sup>	.18	.212 <sup>†</sup>	.166	.245*
RAVLT trial 4	-.08	.19 <sup>†</sup>	.15	.220 <sup>†</sup>	.186	.239*
RAVLT trial 5	-.02	.21 <sup>†</sup>	.19 <sup>†</sup>	.190 <sup>†</sup>	.128	.251*
RAVLT total score	-.11	.21 <sup>†</sup>	.17	.236*	.221	.270*
RAVLT list	-.04	.06	.21 <sup>†</sup>	.084	.139	.149
RAVLT short delay	-.06	.16	.09	.218 <sup>†</sup>	.196	.225*
RAVLT long delay	-.02	.25*	.24*	.208 <sup>†</sup>	.356	.302**
RAVLT recognition	.00	.19 <sup>†</sup>	.20 <sup>†</sup>	.135	.045	.213 <sup>†</sup>
WMS-VR I	-.01	.35**	.29**	.285*	.067	.349**
WMS-VR II	-.02	.53***	.42***	.322**	-.002	.459***

*Note.* WAIS = Wechsler Adult Intelligence Scale; RAVLT = Rey Auditory Verbal Learning Test; WMS-VR = Wechsler Memory Scale- Visual Reproduction.

<sup>a</sup>Spearman's correlation coefficients; <sup>b</sup>Pearson's correlation coefficients.

<sup>†</sup>p < .10; \* p < .05; \*\* p < .01; \*\*\* p < .001.

Table B6

*Mean CMIT Scale Scores for Individuals without and with HIV Associated Neurocognitive Disorders*

	HANDS Negative ( <i>n</i> = 77)	HANDS Positive ( <i>n</i> = 45)	<i>p</i>
CMIT Book 1	46.65 ± 2.74	44.00 ± 5.92	.001
CMIT Book 2	40.52 ± 4.94	37.20 ± 6.42	.002
CMIT Book 3	41.57 ± 5.04	37.37 ± 5.73	<.001
CMIT Book 4	35.60 ± 8.59	29.27 ± 9.91	<.001
CMIT Book 5	48.87 ± 2.76	48.29 ± 3.10	.285
CMIT Total	213.21 ± 17.63	196.13 ± 24.22	<.001

*Note.* Data are given as mean ± *SD*

HANDS = HIV Associated Neurocognitive Disorders.

Table B7

*CMIT internal consistency*

CMIT scale	$\alpha$ (if item deleted)
CMIT Book 1	.721
CMIT Book 2	.664
CMIT Book 3	.671
CMIT Book 4	.731
CMIT Book 5	<b>.808</b>
CMIT Book 5	.721

*Note:* Boldface indicates reliability greater than  $\alpha$  of .768 of original scale.



## APPENDIX C

### IRB Exemption Notice

## APPENDIX C

### IRB Exemption Notice

# PEPPERDINE UNIVERSITY

## Graduate & Professional Schools Institutional Review Board

January 23, 2015

Protocol #: P1114D01

Project Title: On the Validity and Reliability of the Computerized Memory Interference Test

Dear Mr. Karamians:

Thank you for submitting your application, *On the Validity and Reliability of the Computerized Memory Interference Test*, for exempt review to Pepperdine University's Graduate and Professional Schools Institutional Review Board (GPS IRB). The IRB appreciates the work you and your faculty advisor, Dr. Rowe, have done on the proposal. The IRB has reviewed your submitted IRB application and all ancillary materials. Upon review, the IRB has determined that the above entitled project meets the requirements for exemption under the federal regulations (45 CFR 46 - <http://www.nihtraining.com/ohsrsite/guidelines/45cfr46.html>) that govern the protections of human subjects. Specifically, section 45 CFR 46.101(b)(2) states:

(b) Unless otherwise required by Department or Agency heads, research activities in which the only involvement of human subjects will be in one or more of the following categories are exempt from this policy:

**Category (2) of 45 CFR 46.101**, research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: a) Information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and b) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

Your research must be conducted according to the proposal that was submitted to the IRB. If changes to the approved protocol occur, a revised protocol must be reviewed and approved by the IRB before implementation. For any proposed changes in your research protocol, please submit a **Request for Modification Form** to the GPS IRB. Because your study falls under exemption, there is no requirement for continuing IRB review of your project. Please be aware that changes to your protocol may prevent the research from qualifying for exemption from 45 CFR 46.101 and require submission of a new IRB application or other materials to the GPS IRB.

A goal of the IRB is to prevent negative occurrences during any research study. However, despite our best intent, unforeseen circumstances or events may arise during the research. If an unexpected situation or adverse event happens during your investigation, please notify the GPS IRB as soon as possible. We will ask for a complete explanation of the event and your response. Other actions also may be required depending on the nature of the event. Details regarding the timeframe in which adverse events must be reported to the GPS IRB and the appropriate form to be used to report this information can be found in the *Pepperdine University Protection of Human Participants in Research: Policies and Procedures Manual* (see link to "policy material" at <http://www.pepperdine.edu/irb/graduate/>).

Please refer to the protocol number denoted above in all further communication or correspondence related to this approval. Should you have additional questions, please contact Kevin Collins, Manager of the

Institutional Review Board (IRB) at [gpsirb@pepperdine.edu](mailto:gpsirb@pepperdine.edu). On behalf of the GPS IRB, I wish you success in this scholarly pursuit.

Sincerely,

A handwritten signature in cursive script, reading "Thema Bryant-Davis".

Thema Bryant-Davis, Ph.D.  
Chair, Graduate and Professional Schools IRB

cc: Dr. Lee Kats, Vice Provost for Research and Strategic Initiatives  
Mr. Brett Leach, Compliance Attorney  
Dr. Daryl Rowe, Faculty Advisor